INDIAN ENGINEERING:

An Illustrated Weekly Journal.

EDITED BY PAT. DOYLE, C.E.

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GENERAL INDEX.

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MR. E. A. DUKES, late MANAGER of MESSRS. W. NEWMAN & Co., LD., CALCUTTA, is now representing INDIAN ENGINEERING in the Upper Provinces.

CONTENTS.

Answer to Correspondents.

Several matters are unavoidably held over for want of space.

Obituary.

TREVOR—December 5, at Umballa, Major Edward Andrew Trevor, Royal Engineers, aged 47 years.

KAY—December 6, at Howrah Hospital, David Watt Kay, Engineer, Barnagore Jute Factory Co., Ld.

PRESSWELL—December 11, at Allahabad, Thomas Jardine Presswell, Locomotive Foreman, E. I. Railway, aged 41 years and 7 months.

INDIAN ENGINEERING.

SATURDAY, JANUARY 1, 1887.

OURSELVES.

A WEEKLY Engineering Journal is a new and original departure from anything now existing, or ever attempted, in India, and, judging from the encouragement given in other parts of the world to similar publications, we have been induced to believe that the present venture stands a fair chance of success.

India is getting richer and wiser every day, and Engineering plays no small part in this development. The Profession throughout the country is fast increasing in numbers and influence, and an organ representing all branches of it, and affording the members a ready means of intercommunication, is an acknowledged necessity—a want which we now undertake to supply.

"INDIAN ENGINEERING" aims at becoming a centre of information and authority on all matters pertaining to the Profession. The scope of the title includes "every industrial operation, every process of production," as well as "the whole and every detail of the complete science and all the arts of construction."

India is great in Engineering works, and to meet the wants of the great army of workers will be the aim of this Journal, which will not only record the leading incidents in connection with such undertakings, but protect the true interests of the various classes serving on them.

The policy of the Journal will be to create a value for itself as a RECORD of *Indian Engineering*, and to that end arrangements have been made, and sources of information secured, that will, it is hoped, ensure the popularity and usefulness of the organ, and make it even acceptable to those who are indirectly connected with, or co-operate by any means in, the province of Profession.

It is admitted on all sides that periodical literature of this sort in India is not only limited but unsatisfactory. The field of Engineering science and practice has of late years become so extensive in the country, that, to keep pace with the times, an Engineering journal must not only embody everything of importance within its domain, but give the latest intelligence of the day as Professional *news.*

This result will, it is hoped, be achieved by a combination of effort, which will, in course of time, commend itself to Professional favor and obtain the appreciation of enlightened, outside, public opinion.

We believe that the period is opportune for our project, and the encouragement it has already received shows that the Journal has not appeared a day too late in regard to meeting a wide and long felt deficiency.

The Editor begs to acknowledge his obligations to those who have evinced an interest in the venture, and to express his grateful sense of the valuable aid they have given him, not only in placing materials at his disposal for publication, but in generally making known and commending the scheme.

In inviting the Profession at large to help him in producing an Engineering newspaper which will satisfy its wants, he would suggest, in oft repeated words, that brief records of facts from actual Indian practice are what is most required, while hints on the peculiarities incidental to operations and processes carried out in the country, interchange of ideas on difficulties arising in Professional pursuits, or *new* views that might throw light on important subjects, will always be acceptable and receive his best earliest and attention.

Contributions will be published with or without the name of the writer, as desired; nor have those averse to having their names handled by third parties, anything to fear on this score, for the Editor is "a despot," with "whole, sole, undivided control," and their *incognito* may, if they wish it, be perfectly preserved.

RANGOON DRAINAGE SCHEME.

To Mr. O. Deacon Clark, M.I.C.E., Executive Engineer, Rangoon Municipality, belongs the credit of being the first to introduce into India a sanitary improvement of so much value in promoting the public health, as the Shone's Hydro-Pneumatic system. When Dr. Charles communicated to the Indian public the results of his own observation of the Shone's system at Cannes, and suggested its introduction in such towns as Calcutta, he was not aware that the initiative had been already taken by Mr. Clark of Rangoon.

The Shone's Hydro-Pneumatic system of sewerage effectually meets the difficulty as to how the drainage of large and crowded cities, often at a lower level than the neighbouring river, can be most economically carried out. The advantage of this system over other systems for sewering towns situated on a level contour or site, consists in the sewers and drain pipes at all times, and under any circumstances, being laid to command the requisite velocity for making them self-cleansing. Hitherto it has been beyond the power of the Sanitary Engineer to apply at all times the laws of hydraulics, to secure the requisite velocity to make sewers self-cleansing, and hence he has been compelled to adopt the best inclination he could possibly obtain for the sewers, according to local circumstances. But in the Shone system, when a sewer reaches a certain depth, instead of carrying it further at a continually increasing depth, it is made to terminate in an air-tight receiver. Directly the contents of the receiver reach a certain level, compressed air generated at a central station (it may be miles away), and laid on in small air pipes, automatically introduces itself, and sweeps the contents out and up to any height required. When the next sewer reaches a certain depth, the process is repeated, and so on as often as required.

In respect to Rangoon, we learn that by the means described, difficulties arising from deficiency of natural gravitation will be overcome, as the sewers will be laid at steeper gradients than would otherwise be possible for securing the rapid removal of their contents. This rapid flow not only gives immunity from sewer gas, but also renders possible the employment of small pipes. Another great advantage of this Shone's system of pneumatic ejection, is the elasticity of its application to meet the contingency of future expansion of the original sanitary areas. Beyond these advantages is the means which the system offers for improving or supplementing water-supply by pneumatic pressure. By the aid of this pressure, water can be drawn from the lowest outlet of a distributing reservoir, and also made available in the event of fire.

Every town in India is in dire need of drainage, and we believe that the Shone system is that best capable of meeting this need.

We therefore purpose producing in an early issue the complete project for the Sewerage and Supplementary Water-supply of the City of Rangoon on the Shone's Hydro-Pneumatic system—the Report and Drawings having been kindly placed at our disposal for the purpose.

DEHRA DOON RAILWAY.

In another part of this issue will be found an extract from a Mussoorie paper, in which it was lately announced that the Government of the North-Western Provinces and Oudh had deputed an Engineer to go over the line selected by the Local Association which has been promoting a railway from Hardwar, in continuation of the Hardwar branch of the Oudh and Rohilkhund Railway, to Dehra and Rajpore, and to report upon the project which has been prepared by them.

We believe that, besides reporting on the alignment chosen by the promoters, Mr. Hunt has been instructed also to explore all other possible routes for a railway between Hardwar and Rajpore, and that he is now on the ground. The Local Government are therefore undertaking more than they were asked to do by the Government of India, but this will lead to a much more satisfactory settlement of the questions of probable cost of constructing and working the line than would the mere walk over the ground suggested by the Government of India.

We presume that it was owing to the uncertainty felt by Government as to the cost of this proposed railway that the Lieutenant-Governor, Sir Alfred Lyall, made no allusion whatever to it in his speech made last month at Sitapore on the occasion of the opening of the Lucknow-Sitapore section of the railway which is intended to be made through North-Western Oudh to join the Bareilly and Philibhit Railway. His Honor said that only four districts in his jurisdiction remained to be provided with, or placed in close touch with railways, and among them he did not name the Dehra Doon district, which contains the important hill station of Mussoorie, and the Convalescent Depôt of Landour, and through which runs the road to the important military hill station of Chakrata. And yet he named the neighbouring and comparatively unimportant hill district of Garhwal. He could not, surely, have meant that the Dehra Doon district and its towns were adequately served by the North-Western and Oudh and Rohilkhund Railways, which meet at Saharunpore, 43 miles from Dehra; and if he had in view the fact that Hardwar is within a few miles of the boundary of the district, he was probably unaware that there is no

proper road from it up the Eastern Doon, that travelling along the existing track is impossible during the rains. Dehra and Mussoorie are still approachable only by the road which crosses the Siwalik Range by the Mohand Pass, and the thousands of people who annually travel to and from Mussoorie have still to travel 49 miles by the antiquated *dâk gharry* over a road which is intersected by an unbridged hill torrent. But Mussoorie is not the summer seat of the Local Government.

Notes and Comments.

SINGARENI COAL FOR MADRAS.—Hopes are entertained that the extension of the Nizam's Guaranteed Railway through British territory to Bezwada on the Kistna, will, by means of the Buckingham Canal, bring Singareni coal to Madras at a cost of about Rs. 10 per ton.

KISTNAH COAL AGAIN!—The irrepressible Major General Applegarth is still haunted by the phantom of coal in an impossible *locale*—to wit, the Kistnah, where the gallant scientist believes that he discovered the mineral some thirty years back! We should, however, have preferred seeing the recent researches of Mr. Hughes of the Geological Survey quoted by a Madras contemporary than the elaborate views of an enthusiast wholly innocent of his subject.

OIL GAS FOR INDIA.—Rangoon is within measurable distance of being lighted with gas, but the illuminant will be the product of *oil* and not coal. This light will be produced from petroleum by a simple process, to which an old resident of Burma, Mr. Carrier, claims the exclusive right in India. It is declared that a pure white soft light, of from 18 to 20 candle power, can be supplied at a cost which must recommend itself most favorably to consumers.

DEPLORABLE!—We learn that the Government of the Straits Settlements are in difficulties in the matter of a satisfactory survey and recently applied to the Government of India for the services of an experienced officer to assist them. As no officer on the active list could be spared, the Government offered the work to Mr. J. B. N. Hennessey, late Deputy Surveyor-General, who, however, has declined the service, and so the Straits Government remain in the position which destiny and geography have assigned to them. These Colonies comprise Singapore, Penang, and Malacca. Singapore is an island about 27 miles long and 14 wide, while Penang is about half that size containing an area of 107 square miles. Province Wellesley is a strip of Malayan territory containing 237 square miles under the Penang Executive, and Malacca is another strip of somewhat larger extent situate between Penang and Singapore. In the aggregate, of size and population, these appanages of the British Crown do not come up to the average of an ordinary Indian district, while they possess a Surveyor-General, a Deputy Surveyor-General, and several Assistant Surveyor-Generals, with the complement of subordinates, and a Special Commissioner for Lands! Surely there must be something wrong somewhere?

MILEAGE ALLOWANCES.—We believe that one of the matters that came under the Finance Committee was the question of "mileage rates," and that it is in contemplation to restrict the charges on this head to the narrowest bounds possible. We hardly think, however, that there is room for the shears as regards those officers who are compelled to permanently maintain camp or travelling equipage and equipment over and above the extra cost incurred for those special journeys for which mileage is drawn. It should be remembered that no other allowance is admissible during the period for which mileage is allowed or claimed.

AN ANOMALY.—It is announced that the Nizam's Government has, at the request of the Government of India, undertaken the construction of that part of the Bezwada Railway which passes through British territory. This refers to the Singareni Bezwada line. That this undertaking should be entrusted to extraneous agency is not a little incomprehensible, nor is our difficulty diminished by the fact that the Bellary-Kistna State Railway is in active progress towards Bezwada, and that there is a large staff of Government Engineers working in, round, and about the latter place. The belief was that owing to the recent policy of retrenchment the Government of India could not find sufficient work for its own staff of Engineers; nor is the period far back when it placed the services of some of these same Engineers at the disposal of the Hyderabad State for the carrying out of that very scheme of which the Bezwada Railway is only an extension.

THE CHIEF ENGINEERSHIP OF BENGAL.—Speculation is rife as to the coming changes in the P. W. D. Secretariat of the Lower Provinces consequent on the retirement of Colonel Trevor a few months hence. As Mr. J. C. Vertannes shortly goes on leave again with a view to taking his pension, the field of doubt is reduced to but three or four names, among whom that of a well-known member of the "civil element" is said to be the favorite, as it carries with it *both* the essentials of seniority and merit.

BENGAL IRON-WORKS.—We are creditably informed that the Secretary of State has approved of the accounts of this undertaking for the past official year as submitted by Colonel Neill, so that it may be *now* considered a *paying* concern. It is, we learn, the intention to start "rolling mills" at Barakar, as a means of utilising the machinery of the ex-King now lying idle at Mandalay. These appliances are, it is said, capable of milling flat iron bars and round iron from 4 inches to nail rod iron.

RANIGANJ CEMENT WORKS.—We are informed that a local syndicate has been formed to take over the property and work it under different principles than those that previously obtained. From personal knowledge, we can pronounce this to be a really good investment, and we believe that under proper management the concern could be made a most profitable undertaking.

BOILER INSPECTION IN THE MOFUSSIL.—We find that the Government of Bengal has called for an expression of opinion from the Magistrate of Burdwan on the advisability of introducing the Presidency Boiler Inspection Rules into the Raniganj sub-division of that District. The difficulty would be to form a Committee of non-interested members. We agree with the suggestion that the Magistrate should be the *ex-officio* Chairman, and that the Commissioners might be advantageously selected from among independent Government and Railway officials working in the District, but outside local influences.

THE BENGAL-NAGPUR RAILWAY.—The delay in the construction of this line is enshrouded in mystery. The contradictory rumours afloat only resolve themselves into others equally uncertain, and the vague supposition that

"matters are being settled" is perhaps, under the circumstances, the easiest solution of the question of the position of the project. There are, however, signs favorable to an early resumption of work, but under what agency we cannot at present foretell. The Engineers along the line have been recently directed to travel over the whole of their respective charges and take stock of everything, "so as to be ready to hand over when necessary." This looks hopeful.

MADRAS HARBOUR WORKS.—The Trustees are of opinion that should Government consider it necessary to retain Mr. Parkes on the permanent staff of the re-construction works as Engineer-in-Chief, he should receive his instructions direct from the Board; but they are also of opinion that his services might be more economically availed of, if required, as a Consulting Engineer merely, should the Board at any time desire to refer to him for a professional opinion. It would, indeed, be a pity if Mr. Parkes were to sever his connection with a scheme of which he knows more than anyone living. This special knowledge is well exemplified by the fact that nine or ten years back Mr. Parkes counted upon the accretions, to the south of the Harbour, becoming property of considerable value, and regarded the same as a set-off to the heavy expenditure that would have to be incurred on account of the erosion to the north. We may incidentally add that Mr. F. N. Thorowgood, the Superintendent, reports undoubted silting in the south-west corner (inside) of the Harbour, but until we are in possession of detailed information, it would be premature to make any remarks on this subject.

IMPORTANT CONTRACT GIVEN TO FRENCH SYNDICATE IN CHINA.—News has been received from Tientsin that the Viceroy has made over the whole of the harbour works of Port Arthur, the Great Naval Station of the Pei Yang, to a French Syndicate, who have contracted to do the work for £300,000. If the harbour and docks are to be made really serviceable for that amount, the Chinese have perhaps made a good bargain, but there may be items not provided for in the contract which may swell the nominal outlay. The French have certainly managed this business with even more than their usual ability.

TIN-MINING IN MALAYA.—The Selangore Tin-mining Company, the career of which affords a good example of the rise and fall of enterprises started without any practical knowledge, is as dead as dead can be. The Ampang mine in the same part of the Peninsula bought by the Straits Mining Company has resulted in very heavy losses for the English Company. The Johore Tin Streaming Company is another short-lived concern added to the roll of mining bubbles. We might continue swelling the list of disastrous enterprises if we were disposed and could find space for such phases of sensation in the recent history of Malayan tin-mining.

THE BOMBAY FLOUR-MILLS.—It has been observed that India, as the cheapest wheat-producing country in the world, and with her cheap manual labour, ought to be able, not only to supply her own wants in respect of flour of sorts, but to compete successfully in foreign markets. But, unfortunately, the actualities are just the other way, for last year 2½ million pounds of flour had to be imported from abroad, and the local flour-mill business of Bombay is laboring under a severe depression. This has been ascribed to various causes, but the truth probably lies in the fact that the inter-competition among the flour-mills has been overdone.

Current News.

THE opening of the Marmagoa Railway has been postponed from the 2nd to the 15th instant.

THE Jardine prize of the Rangoon College was gained by Moung Pothoung, of the Seebpore Engineering College.

THE G. I. P. Railway Directors have declared an extra dividend of £1·4 per cent. in addition to the guaranteed interest already paid in respect of the half-year ended 30th of June last.

WE regret to hear that Mr. Robert Cunningham, Chief Engineer of the Irrawaddy Flotilla Co's. Steamer *Aloungpyah* was accidentally drowned at Donabyn on Thursday last. He leaves a widow and family in Glasgow.

MR. YOUNG, Assistant Engineer, Madras State Railway Surveys, is transferred to the Nizam's State Railway, and Messrs. Lackerstein and Gilchrist, Executive Engineers, of the same branch, are under orders for Burmah.

THE Calcutta Jute Manufacturers' Association has decided, we learn, in view of recent over-production, to work nine days, a fortnight, for the twelve months from the 15th February; say four days one week, and five days the next.

THE attention of the Madras Government has again been drawn to the advisability of adopting the Abt system in the construction of the proposed line of railway up the Neilgherries, as this system has been so successful in ascending steep gradients on the Continent.

CAPTAIN A. R. F. DORWARD, Royal Engineers, will officiate as Commanding Royal Engineers with the Upper Burmah Field Force; and Captain F. T. N. Spratt, Royal Engineers, has been appointed Director of Military Signalling in Upper Burmah, as a temporary measure, in addition to his other duties.

THE handsome building, erected on the site of the former Engineer Office, H. H. the Nizam's Government, at Chudderghât, as the Central Office, P. W. D., is completed, with the exception of a few internal fittings, which are being actively pushed on. Exteriorly the building presents a remarkably striking and elegant specimen of architectural design.

MAJOR CAMPBELL, R.E., Superintending Engineer of the Tank Department, Madras, was recently offered by the Madras Government an appointment in Upper Burmah as Chief Adviser to the Government Irrigation Department, on an increase of salary of Rs. 300, and prospects of early promotion, but that officer has expressed his unwillingness to accept the post as he proceeds on furlough early next year, and has completed his arrangements to do so.

COLONEL C. J. SMITH, R.E., Consulting Engineer for railways in the Madras Presidency, has arrived in Calcutta for the purpose of discussing with Sir Theodore Hope the proposed railway extensions in that Presidency. One of the first projects to be discussed will be the proposed line to Bezwada, for the purpose of opening out the Sangerini coal fields, the early construction of which has already been recommended by the Secretary of State for India.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

UNFAIR COMPETITION.

SIR,—I regret to say that I have been out of employment for the past twelve months, notwithstanding my very utmost endeavours to obtain it anywhere—even in China, Burmah, or Beluchistan, taking all their risks, and, withal, I have failed. I have had some twenty years' extensive practice in some of the heaviest and largest works in the country, on Guaranteed and State Railways, and hold testimonials of the highest character from some of the best Engineers that have been in India—all to no purpose, and I believe there are numbers quite as badly off as myself.

I believe the cause of all this is,—*1st.*—That nearly all the Engineering works of the country are in the hands of the Government. *2nd.*—The large number of men sent out annually from Cooper's Hill. *3rd.*—The unfair practice of the Government in lending their D. P. W. Engineers, that are already provided for, to Municipalities, District Boards, Native States, and to private Railway Companies, and to other kinds of work, that may be set in motion by private people with private funds, quite unconnected with the Government. *4th.*—By English contractors, such as Glover and Co. and Kirby and Co., and some others, who bring men out for their works, while many as good, if not better, are idling in the country for want of work.

I can mention a few outside private works that Government have lent their Engineers to: *1st*, the Indian Midland; *2nd*, Southern Maratha; *3rd*, the Nizam's; *4th*, the Rajah of Morvi's Railways; *5th*, Cashmere State Roads; *6th*, Rawal Pindi Water and Drainage Works; *7th*, Patna ditto. These are a few that I can bring at this moment to mind, but I have no doubt, that all the other unemployed Engineers could each bring many others to notice in their several districts. All this is very unfair to us on the part of Government. If they have more Engineers than they know what to do with, they should curtail their annual supply from Cooper's Hill, which in itself is a standing injustice to the Indian Engineering Colleges. They have no right to lend their

Engineers out to private works, preventing those in the open market from earning their bread, or obtaining the employment they are entitled to.

I saw in the *Pioneer* sometime since, a letter to its Editor, complaining in exactly the same words as the above of this great injustice to us. These letters singly are not of the slightest use; they are read, but soon forgotten, and leave little or no impression on those who rule the great D. P. W. Nothing will have any effect but a combination of all Engineers outside Government service, domiciled in this country, both in and out of employment, to take measures to consider this most important question in as public a manner as possible, pass resolutions, and to memorialize the Governor-General in Council on the matter for a stop being put to the scandal which operates to the detriment of the many unemployed. If the Government would only do their duty in this respect, we, the unemployed, should be able to find work to do, and benefit the country much more than lent D. P. W. men would ever be able to do, for various and many reasons.

BOMBAY; 12*th December* 1886. R. J. I.

[We can sympathise with our correspondent and others situated like himself, and shall be glad to help the cause as far as our space will permit. We have just learned that the Gwalior Durbār is establishing a D. P. W. of their own, and that the Government of India is about lending some of its own Engineers to fill it up. If our information be correct, we can only say this is hardly fair to the many not in Government service wanting work, including several passed men from the Indian Engineering Colleges.—ED., *I. E.*]

KOSI BRIDGE, KHAIRNA.

SIR,—I noticed in the *Engineer* of the 19th November last a design for a bridge to be erected over the Kosi River, the materials for which are to be supplied in England.

Whatever the idea may be that this construction is intended to convey, there is very little likelihood of it being overlooked as an obvious waste of material and money, and one of those glaring instances (not a few in number) which will be pointed out to the people of this country in strong words of condemnation. It is not, I believe, considered a rule with a Government Engineer to give his design a thought as to what the probable cost of it may be, but he sets his mind to have it carried through, let it come to what it will, his main object being to produce something which he imagines will make a mark in the profession.

In the case before us, here we have a *Roadway Bridge* with a span of 210 feet having material employed in it which has been calculated to weigh as much as 240 tons. In the name of common-sense, I would like to ask, of what use is all this material, and what strain is the Bridge supposed to sustain? The scantlings of L bars and steel plates are very little less than if they were to be of iron, and it looks doubtful if the structure will not a short while after completion shew a very distinguishable *set*.

It was not my intention to criticise the plan so much for fear of being thought too presumptuous, but to point out the utter folly of ordering a work of this description in England, whereas if competition designs were called for from English firms in India, I am sure that the result would be a better and cheaper structure, and one that could be carried out without incurring any risks far more expeditiously.

J. N. C.

Literary Notices.

THE INDIAN SCHOOL ALGEBRA. *By J. W. Cassels, M. A.* Madras: The S. P. C. K. Press, Vepery. 1886.

THIS little work is one more added to the number of attempts made to meet the ever constant educational "want" which furnishes the "reason why" for so many school-books. It is intended to supply students, who are preparing for the Middle School and the Matriculation Examinations held in India, with a complete but inexpensive treatise on Algebra. The author concedes that he has built on the old lines followed by European writers on the subject, but claims new arrangements which render the book better adapted to the requirements of Indian students. The qualifications which he brings to bear on his task are those of an ex-scholar and wrangler of Cambridge. It may be added that Mr. Cassels is a Chaplain on the Madras Establishment, and sometimes Mathematical Examiner of the South Indian University. The object kept in view throughout his look has been not merely to show how examples are to be worked, but to explain the principle involved with clearness and brevity. The exercises are numerous, well selected, and judiciously arranged, while the Test Questions on the book-work are a novel feature, certain to prove useful alike to tutor and pupil. In other respects, the work is nicely got up, the typography being better than anything of its kind we have yet seen produced in India.

THE JOURNAL OF THE ROYAL ASIATIC SOCIETY OF GREAT BRITAIN AND IRELAND. *Vol. XIII., Part 4, October 1886.*

THERE are two communications in the present issue of this well-known publication which might interest our readers. The first is an article on Ancient Sculptures in China which affords valuable subjects for students of comparative archæology. The next is a description of the Mosque which stands in the centre of the Citadel of Cairo, by Major C. M. Watson, R.E. This was at one time one of the richest and most magnificent mosques in Egypt, but is now little else than a ruin applied to secular purposes. Both articles are amply illustrated, and the elevation of the Mosque is worthy of note as showing a minaret of a description by no means common, the stones being carved in a bold zigzag pattern, while the summit is covered with green enamelled tiles beneath which an Arabic inscription encircles the column.

QUARTERLY JOURNAL OF THE ROYAL METEOROLOGICAL SOCIETY. *October, 1886.*

THIS number, which completes Vol. XII, contains much valuable and useful matter. Mr. Harding in his paper on the severe weather of the winter of 1885-86, arrives at the conclusion that the abnormal conditions which prevailed over the British Islands last season, extended not only over nearly the whole of Europe but a considerable distance to the westward—thus showing a general reversal of conditions over a great part of the Northern Hemisphere. Mr. L. M. Cassella describes an Altazimuth Anemometer for continuously recording the vertical angle as well as the horizontal direction and force of the wind. It was observed in the discussion on the subject that in considering the question of anemometers and their indications, it was always desirable to remember to what uses the indications of the instrument were to be applied, whether for engineering purposes or meteorological purposes alone, to both of which the Altazimuth instrument described was equally well adapted, whether as indicating the angle direction and force of the gust that blew down the Tay Bridge, or direction and power of the wind at different altitudes and under varying circumstances. It was thought that anemometers should be placed much higher than they usually are, and that the practice in India of placing the instrument at different heights ranging from 5 to 70 feet, and treating all the observations as of equal value was objectionable. Mr. Clayden's note on the "After-glows of 1883" is another theory to account for the optical effects which succeeded the great Krakatoa eruption. This theory ascribes the phenomena in question to the water vapour erupted from the volcano, and to some extent reconciles the "dust" and "humidity" theories of the marvels that followed the ever memorable catastrophe.

THE INDICATOR DIAGRAM PRACTICALLY CONSIDERED. *By N. P. Burgh, A. I. C. E. &c.* London: William Clowes & Sons.

THE author of this well-known manual has produced no less than a dozen different works at various times, all more or less dealing with the one same subject of prime movers in their diverse aspects. He is a recognized authority in modern marine engineering, and his treatise on "Boilers and Boiler-making" has earned him lasting repute. It would, therefore, be superfluous for us to say anything on the merits of the volume now before us, further than that it is the sixth edition, with an appendix bringing the information afforded down to the present time, which considerably enhances its value as a really practical work on the entire subject of "Indicator Diagrams."

SANITARY INSTITUTE OF GREAT BRITAIN.

IT having been pointed out to the Committee that the wording of the circular relating to the issue of Mr. Simons' Public Health Works is open to a little misconception and might lead to the thought that Mr. Simons intended to re-write or make alterations in the matter published, the Committee desire to make it known, that the publication will only be a reprint of Mr. Simons' writings as they appear in various official reports, although he has kindly consented to advise the Editor in the arrangement and selection of the matter.

General Articles.

REPORT ON DESIGN PREPARED FOR THE COLLEGE FOR THE CHIEFS OF THE PUNJAB AT LAHORE.

In accordance with an advertisement issued by the Punjab Government, inviting competitive designs for a College for the sons of rulers, chiefs and native gentlemen of position in the Punjab, twenty-nine designs were submitted. The committee who examined these designs came to the conclusion that not one of them could be accepted as it stood. It was, however, generally recognised that the ground plan and general arrangement of buildings proposed in the design signed "Non nobis solum" were not only superior to those in the other designs but excellent and convenient in themselves. The elevation of this design, however, was generally disapproved. The clock tower was especially objected to, and it was felt that the College authorities had no other course but to reject the scheme as a whole; but among the other designs was one submitted by "Justitia" which, while defective in ground plan and in some constructional details, appeared to the examining committee to be very graceful and pleasing in elevation. As a whole, this design was rejected, but the committee made arrangements to obtain the use of the elevation of this design, prepared by Ram Singh the Head Assistant in the Mayo School of Art, Lahore, under the supervision of the Director, Mr. J. L. Kipling, and proposed to the author of the design, whose ground plan was approved, that he should submit a design adapting the elevation by "Justitia" as far as possible to his ground plan.

In accordance with this proposel a revised design was submitted in pencil for approval, and it was returned generally approved, subject to suggestions contained in a memorandum from the Secretary to the Punjab Government in the Public Works Department.

The design now submitted, to which these drawings refer, is the result.

The ground plan is the same as was originally approved. The accommodation provided as required by the advertisement is as follows, all dimensions being in *feet*:—

Theatre or Speech room	64 × 30
Five Class rooms, each	22 × 30
Library	42 × 30
Play room	30 × 20
Laboratory	30 × 20
Principal's room	22 × 20
Visitors' room	22 × 20
Office	22 × 20
Lavatory accommodation	12 × 12

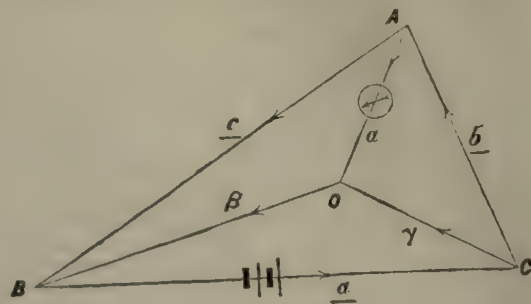
In addition to the above, though not required by the advertisement, the following accommodation is also provided, as very desirable in a building of this kind,—especially in an Indian climate:—

Entrance Hall	30 × 20
Verandah projecting to do.	32 × 12
A covered Portico (with recesses in the walls for College notices)	
Vestibule to Theatre	30 × 12
Tribaras on each side of Vestibule	22 × 12
Verandah to Principal's room and each Class room	12ft. wide.
2 Store rooms under stairs	13½ × 6
Verandah all round Play room and Laboratory	12ft. wide
A Separate Staircase and entrance to Library with open Terrace	30 × 12
Two Galleries at each end of Theatre each 30 × 12. are provided for the convenience of ladies or others.	
A Recess or space for a stage	18½ × 15

With a view to meet the stipulation that the plan must be so arranged as to admit of the construction of the Theatre or Speech room, together with the five Class Rooms and Lavatories, as a separate building complete in itself, yet capable of having the other accommodation added when required, all these rooms are provided for in the main block. The Library, Play Room and Laborstory are designed as a separate block, and can be added at any time without impairing the masonry of the design.

(To be continued.)

NOTE ON WHEATSTONE'S BRIDGE.



The diagram represents a Wheatstone's Bridge for the measure of electrical resistances. A battery is supposed to be in B C and a galvanometer in A O. The points A B C O are usually called the vertices. The resistances of B C, C A, A B, A O, B O, C O are taken to be a, b, c, α, β, γ, respectively. The battery resistance is included in a and the galvanometer resistances in α. The current through α would be given by an equation $I=\frac{E}{R}$. It is known that there is no current if $b\beta=c\gamma$. Therefore for I we expect a more complete formula of the form $I=\frac{E\ (b\beta - c\gamma)}{D}$.

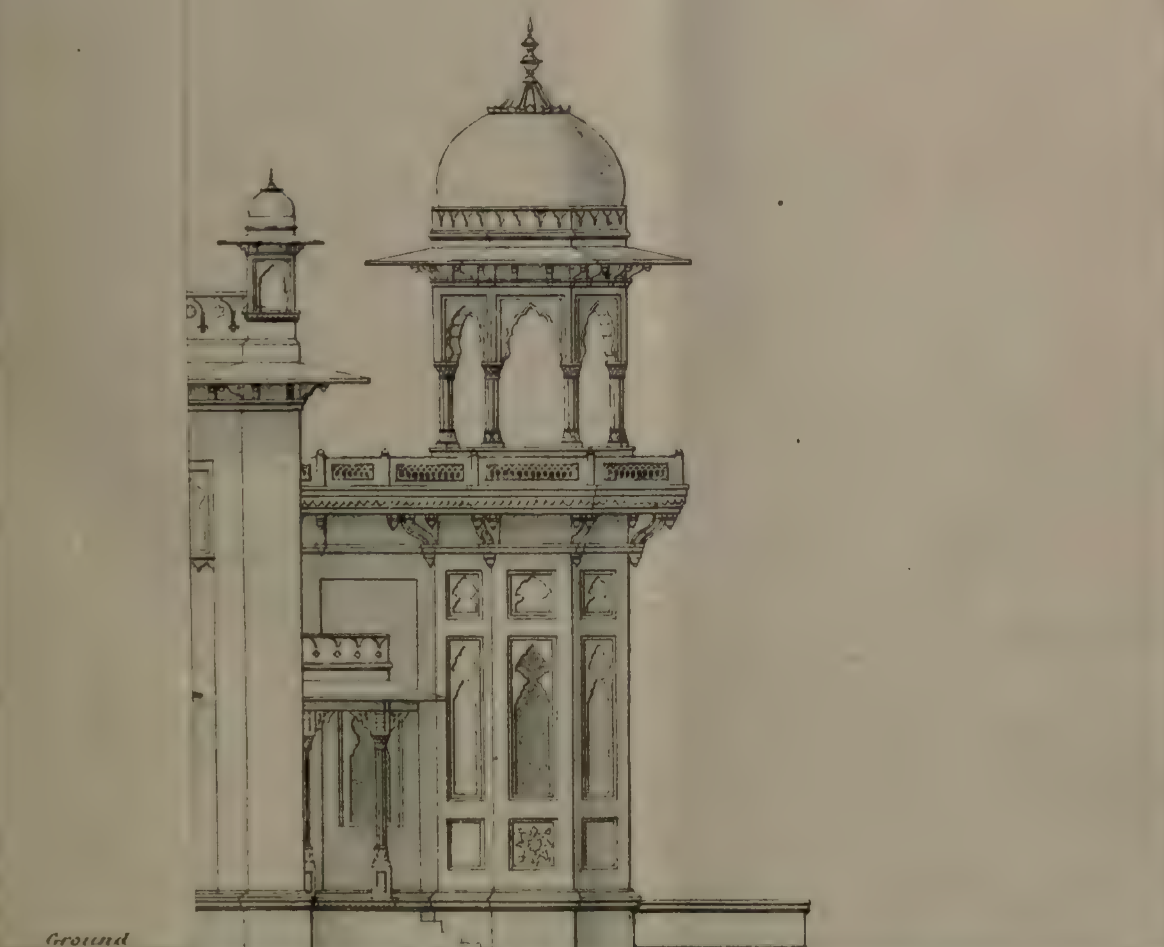
D must now be a homogeneous expression containing the six resistances and it must be of the third degree. Accordingly when the value is worked out as in the ordinary text books we get the expression—

$D=a\,b\,c+b\,c\,(\beta+\gamma)+c\,a\,(\gamma+\alpha)+a\,b\,(\alpha+\beta)+(a+b+c)\,(\beta\gamma+\gamma\alpha+\alpha\beta)$. Although this expression is not without a certain symmetry it is still formidable to carry in the memory. We proceed to find a simpler mode of defining D.

The combinations three together of the six quantities $a\ b\ c\ \alpha\ \beta\ \gamma$ are twenty in number. The above value for D has only sixteen terms. Therefore four combinations are missing. These prove to be $b\,c\,\alpha$, $c\,a\,\beta$, $a\,b\,\gamma$, and $\alpha\,\beta\,\gamma$.

Now each gives a set of three lines meeting in a vertex. Hence results a new and simple rule for the formation of D: *Write down all the combinations three together of the six quantities $a\ b\ c\ \alpha\ \beta\ \gamma$. Then strike out any combination which gives three lines meeting in a vertex.*

Secondly, we may inquire why these particular combinations are unsuitable as components of D. Let the directions of the currents be given by the arrows in the diagram and suppose the resistances so chosen that the current in α is moderately great, say not less than one-tenth of the current through the battery. If now the resistances a, γ, β, be kept constant while $b\ c$ and α are each increased so as to keep the same ratios towards each other, changes will take place in the values of the potentials at C O and B and in the current through the battery. But even if $b\ c$ and α become infinite the battery current remains finite, *i.e.*, it does not vanish. The values of the potentials at C, O, B and the current value through the battery will take what may be called ultimate values. Then if $b\ c$ and α, though not infinite, are large—say of the first order of large magnitudes—the potentials and the current through the battery will differ by small quantities from the ultimate values. The potential at A depends on the potentials at C and B and also on the ratio which the resistance between C and A bears to the resistance between A and B. This latter gives a divided circuit, *viz.*, A B and A O+O B. But A B and A O are become large while O B has kept its initial value. Therefore the resistance between A and B has been increased nearly in the same ratio as that between C and A has been increased. Therefore after $b\ c$ and α have become tolerably large, so that the potentials at C and B are near their ultimate values, the potential at A will remain nearly constant and will depend on the ratios initially chosen between $b\ c$ and α. Also the potential at

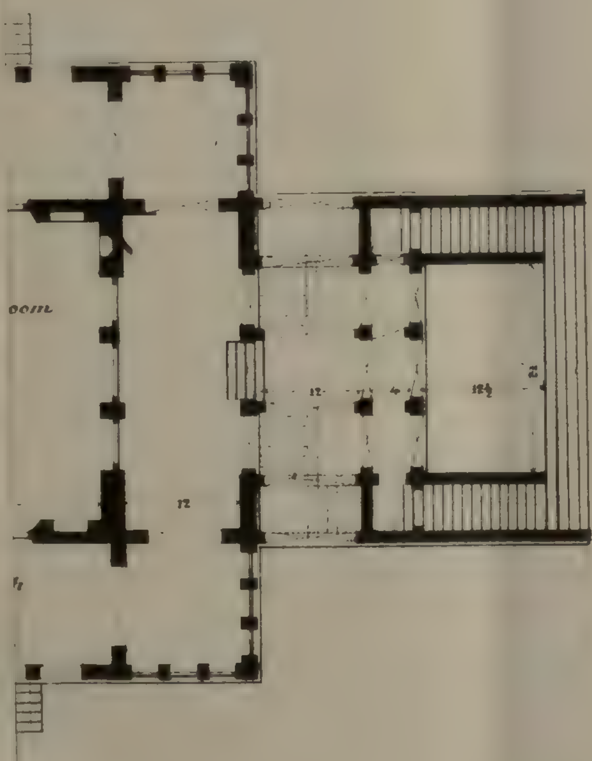


Ex Engineers Offi
Jeypore

S.S. Jacob. Lt Colonel
Executive Engineer

REFERENCES.

1	*Theatre or speech room*	64×30
2	*Principal's Room*	20×22
3	*Five Class Rooms*	20×22
4	*Visitors Room*	20×22
5	*Office*	20×22
6	*Lavatory Rooms with*	12×12
	Swing doors	12× 9
7	*Store Room below stairs*	18½× 6
8	*Laboratory*	20×30
9	*Play Room*	20×30
10	*Library (above 8 and 9)*	42×30



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J. S. Jacob. Lt Colonel
Executive Engineer

O will finally depend chiefly on the ratio of γ to β besides on the potentials at C and B. Thus we have some finite difference of potential between A and O. In fact we may choose this finite difference by suitable selections for b c and a after we have arbitrarily chosen α β and γ. But as a has become a large quantity of the first order, the current through a has become a small quantity of the first order.

The value of the current is given by the equation—

$$I = \frac{E\ (b\beta - c\gamma)}{D}$$

The factor $b\ \beta - c\ \gamma$ has become a large quantity of the first order. Therefore the denominator must be a large quantity of the second order. But if D contains the term $b\ c\ a$, D would be a large quantity of the third order, *i.e.*, the current would be a small quantity of the second order. Therefore the term $b\ c\ a$ must be absent from *D*. By changing the position of the battery and galvanometer we may in like manner show that the other three terms $c\ a\ \beta$, $a\ b\ \gamma$, and $a\ \beta\ \gamma$, should be absent.

A. Ewbank.

AN ARTESIAN BORING.

The Rev. James Doyle, Catholic Priest, writing from Place's Garden, Kilacheri, (Chingleput,) sends us the following:—

It is perhaps not generally known that a piece of Engineering of more than ordinary importance is in progress at Perimbaukum, in the Conjeveram Taluq, on some property belonging to the local Irish Mission, known as Place's Garden, and also as "The Monastery." It is an Artesian Well that is being bored by Mr. Alaguianada Odiar, son of Arponda Odiar, of Pondicherry. Mr. Alaguianada Odiar is an amateur, who has already achieved considerable success in this particular line. He was educated at the Petit Seminary of the French Foreign Missions, Pondicherry, and gained his Engineering experience under M. Charles Poulian. He has up to date bored four wells: two on his property, and two others on lands belonging to private individuals, but all in French Territory; and has a fifth on hand in the same place; for, though he has tapped a spring at a depth of 180 feet, he hopes, by boring deeper, to obtain a much larger supply. Mr. Alaguianada Odiar was induced to bore for water in the present locality, independently of a charitable desire to benefit the Monastery, from the example of M. deClosets, who had undertaken to bore for water at Picbibaukum, a village five miles to the west of Perimbaukum, and was forced to abandon that project after having reached a depth of 108 feet, in consequence of the pipes having snapped, at least so I am told. The present boring was commenced on the 17th of last May, and has been worked since, with but one intermission of about a month in August-September, when Mr. Alaguianada Odiar went on a visit to Pondicherry. The diameter of the pipes in this, as in all other of Mr. Alaguianada Odiar's borings, is 7½ inches. The following description of the strata pierced may prove of interest to some. I give the names of the rocks as they were described to me, and from what I was able to make out of the specimens shown me, and trust they will be a sufficient substitute for their technical names, with which I am not conversant:—

8 feet	Vegetable mould
2 „	Red earth
4 „	Red earth mixed with sand
26 „	White sand
42 „	White sand mixed with stones
3 „	Yellow clay mixed with white sand
2½ „	Yellow clay mixed with black sand
9½ „	Marbled clay, red
12 „	Marbled clay, black
2 „	Yellow clay
4 „	Marbled clay, gray
1 foot	Marbled clay, chocolate
2 feet	Marbled clay, black
1 foot	Grit
28 feet	Slate
2 „	Silicious rock
4 „	Auriferous rock.
152 „	Total.

Slate again occurs below this, but the actual process of boring has been discontinued for the last few days (19th October) in consequence of a quantity of sand having fallen to the bottom through an accidental upheaval of the pipe, and this sand is being pumped out. The auriferous rock appears to be rich in the precious metal, and the marbled clays are very pretty in blocks. The cost of working this boring is much lower than what it might be. Mr. S. A. Alaguianada Odiar supplies the talent and machinery *gratis*. The motive power is manual, and is drawn chiefly from the native orphanage on the premises. A blacksmith from a neighbouring village is also employed on eight annas a day. This man was taken to some actual borings at Pondicherry, to get an idea of the work that he would be required to do. Perhaps Government might do worse than show their appreciation of the enterprise. The village of Perimbaukum lies some five miles to the south of the Kadambatur station on the Madras Railway Line. Place's Garden lies just behind this, and in it is a monastery of native monks, who, amongst other duties, have charge of an orphanage for native boys. The Rev. Father Dominic, in charge of these establishments, will be happy to welcome professional and other gentlemen who may be desirous of visiting the boring.

[We have been favoured with specimens of the strata detailed above, and find them as described,—except as regards the supposed "auriferous rock," which, on closer examination, yields "iron pyrites" instead of the more precious metal. Mr. Mallet, of the Geological Survey, who examined the tiny specks for us, through the courtesy of Mr. Medlicott, in pronouncing this opinion adds, that the mineral (pyrites) from its yellow color and metallic lustre, is often mistaken for gold.—Ed., *I. E.*]

THE HOOGHLY BRIDGE.

The design of bringing the East Indian Railway across the Hooghly had been often seriously considered, very many schemes proposed, and many Committees assembled to discuss them. At last a site for a bridge in the vicinity of the village of Hooghly, about 23 miles north of Calcutta, was selected as the most favorable position for crossing the river and forming a connection with the Naihati station of the Eastern Bengal (now State) Railway. The first estimate for a bridge at this site, made by Mr. Bradford Leslie, the Agent and Chief Engineer of the East Indian Railway, in August 1879, amounted to only 14½ lakhs of rupees. The design was original; and its great element of cheapness lay in the manner in which old rails were to be utilised in the construction of the girders. This design, however, was not accepted in England; and the present design, which is also a strikingly novel one, is the joint production of Mr. Leslie and Mr. A. M. Rendel, the Consulting Engineer to the East Indian Railway Company in England.

The bridge now practically completed is the first *cantilever* bridge in the East, and illustrates the special advantages of that novel form of construction. We learn from the Transactions of the Scotch Institute for March last that the piers for the centre cantilever are 120½ feet apart centres. From high water mark to foundation of piers is 90 feet, and the piers are formed with a steel shell with semicircular ends, measuring 66 feet by 25 feet over all, with upper portions 55 feet by 25 feet, on which girders and wind struts rest. These shells are strongly constructed, and braced internally and filled in with concrete. From foundation to seat of girders, the piers measure 112 feet over all. The shore girders, which rest one on each side of the cantilever span, are each 420 feet long, resting *solid* on seat formed on ends of cantilever, and having pendulum bearing to allow for expansion on abutments, and form one clear span of 540 feet on each side between pier and abutments—less width of bearings. The two shore spans of 420 feet each were made at Gateshead, and required a total of 1,800 tons of steel, whilst the double central cantilever made at Motherwell required over 1,400 tons of steel. A view of the latter in position is given in the advertisement pages of the Home technical journals, by the makers, James Goodwin & Co., Glasgow.

While reserving our comments for some future occasion, we endorse the opinion of the Calcutta *Englishman* that the completion of the Hooghly Bridge is a work that may well attract public attention; for, whether regarded from the commercial point of view, or as a great engineering achievement, it may rank with any public work of utility in India.

IRON BRIDGES IN MALABAR.

MR. GEO. ANDERSON, M. I. C. E., Local Fund Engineer, has the credit of having solved the difficult problem of how to provide, at a moderate cost, durable superstructures for bridges calculated to withstand the Malabar climate. Mr. Winterbotham, C. S., says in the last Local Fund Report of that district that, nothing can be more disheartening to any one interested in the upkeep of communications in Malabar than the apparent impossibility of permanently bridging the rivers and streams which intersect and block the chief lines of road. He adds: "No sooner is one bridge built than another falls, or is condemned as unsafe. I have not had time to prepare a list; but I believe I am within the mark in saying that nearly one hundred bridges, built of timber or laterite within the last quarter of a century (many of them at an enormous cost), have either been entirely swept away leaving nothing but the abutments to testify to their former existence,—or, if still standing, are in a condition so precarious that it is doubtful whether they ought not at once to be closed to traffic. As funds become available these tottering bridges are taken up one after another for reconstruction or repair; but the only result of this piece-meal system is that on one and the same line of road there shall be found one or two iron-girder bridges, new and in splendid condition,—three or four wooden bridges, worm-eaten, creaking and rotten,—and an equal number of streams, where nothing remains of the bridge but the abutments, and which must be crossed in the primitive ferry boat of the country. Until some material more durable than timber and less costly than iron or masonry be discovered, it seems as if the board could never hope to maintain the host of existing, falling, and fallen, bridges, each one of which at one time or another it has been considered indispensably necessary to erect."

The initiative taken by Mr. Anderson has yielded the bold departure for Southern India evinced in the Iritti and Merumpoya bridges now approaching completion. Both bridges consist of iron superstructures of Whipple-Murphy pony trusses resting on masonry abutments and piers.

We illustrate one of these Trusses on the single trellis system, 72 feet clear and 76 feet effective span and a clear roadway of 14 feet, ten spans of which are being constructed by Messrs. Burn and Co, Howrah, for the District Board, Malabar, three for the Merumpoya and seven for the Iritti rivers. These bridges are of a very neat and light design, and have been constructed to carry a load of 120 lbs per square foot of roadway or a total distributed load of 60 tons, under which it is not to deflect more than $\frac{1}{1200}$ of the span or have any permanent set. All the joints, with the exception of those in the top-boom, (each length of which has butt joints, and they are bolted together by turned bolts,) are fastened together by steel pins $3\frac{1}{4}''$ diameter, which facilitates the conveyance of the different parts over rough country, and the erection when skilled labor is scarce. The main girders have an effective depth of 9′–6″, being one-eighth of the effective span, and are divided into eight bays, each of which is equal in length to the effective depth 9′–6.″ The camber on each girder is 2″, which necessitates the portion of the top boom in each bay being made $\frac{1}{4}''$ longer than the bottom boom or cord. The top boom is composed of 4 angle irons, $4' \times 3'' \times \frac{7}{16}''$ placed in the form of two channel irons $8' \times 3''$, back to back, between which the diagonals and struts are fixed by the steel pins. The top flanges of the angle irons are braced together by $2'' \times \frac{3}{8}''$ flat iron diagonals and of the same section throughout. The lower boom or cord is composed of two flat iron bars varying from $5'' \times \frac{5}{8}''$ at the centre to $5'' \times \frac{3}{8}''$ at each end of bridge, forming solid links 9′–5″ long from centre to centre. The diagonal ties are also composed of similar links, and the struts are of T iron with eye plates rivetted on each end to fit steel pins and plates joining the flanges at intervals to prevent breaking. The roadway is carried on cross girders which are $12\frac{1}{2}''$ deep and have 4 angle irons, $2\frac{1}{2}' \times 2\frac{1}{2}'' \times \frac{3}{8}''$, for the flanges, these are placed 9′–5″ pitch and are fastened to the bottom boom by a strap rivetted on to the web through which the steel pin passes which connects the lower boom and ties together. On the cross girders longitudinal rolled iron beams $6'' \times 5''$ are placed which carry the road planking. Tho top boom is well stayed from the ends of the cross girders, which project 3′–2″ on each side of bridge by a T iron strut $5' \times 2\frac{1}{2}'' \times \frac{3}{8}''$. The platform has $5' \times 2\frac{1}{2}'' \times \frac{3}{8}''$ T iron wind bracing placed diagonally under the cross girders from one end of the bridge to the other. The bridge weighs about 20 tons per span, and no piece will exceed one and half tons. The contract price for the 10 spans is Rs. 58,000 delivered at Malabar.

The rules of the Government of India did not admit of the District Board ordering the iron work from England, otherwise than through the Secretary of State, whose estimate of the cost was considered by the Board exorbitant. After much inevitable delay the Government of India allowed the Board to accept the tender of Messrs. Burn and Co., Howrah, and the result shows that local firms can favorably compete with English makers.

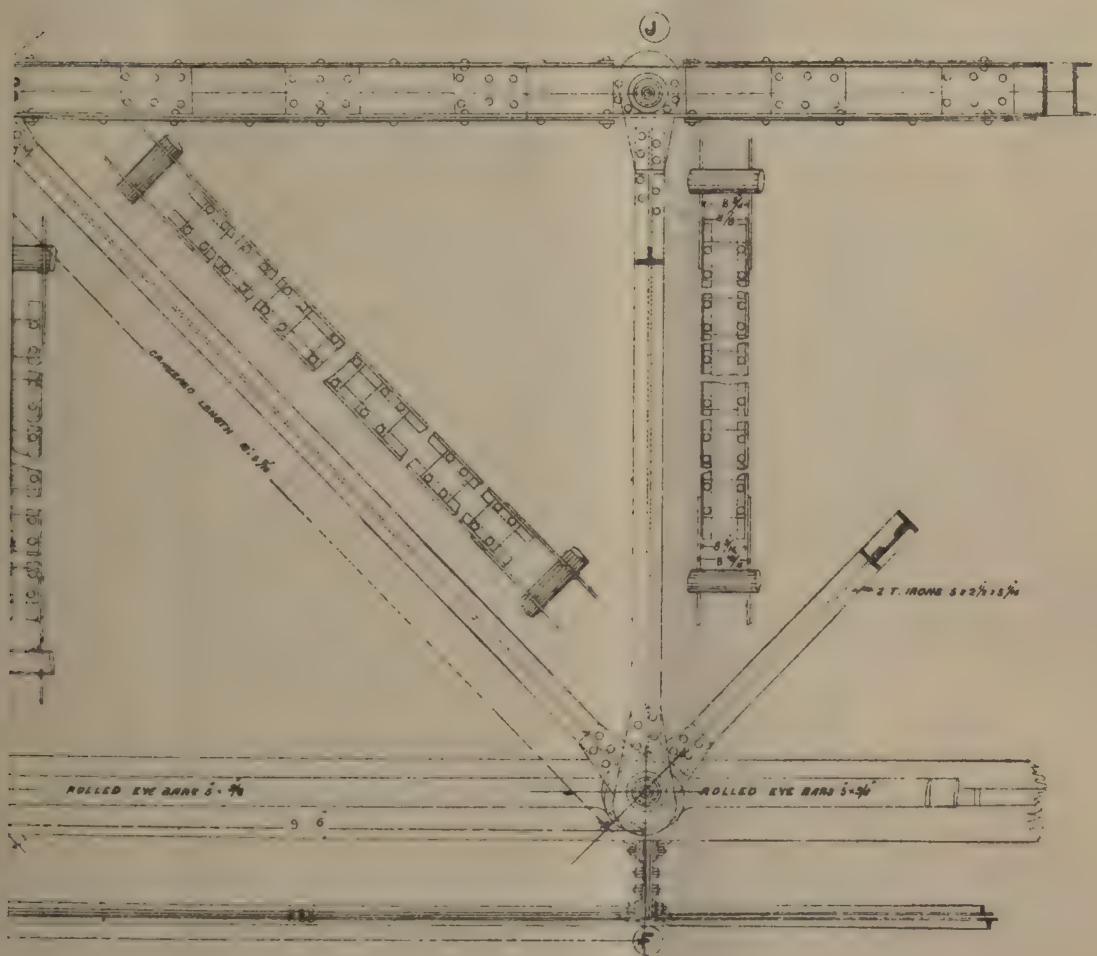
SEEBPORE ENGINEERING COLLEGE.

THIS Institution is situated on the right bank of the River Hooghly—East of the Royal Botanical Gardens. When viewed from the river, it is a sight not easily forgotten. On going over the grounds, you are struck with the cleanliness of the place, and the sanitary improvements that have been made of late have converted it from a "hot bed of malaria" into the "one healthy spot in Seebpore." The quarters alloted to the students are large, airy, and comfortable. This College is intended to train young men for both branches of the Engineering profession, *viz.*, the Civil and Mechanical. The course of study is of a high standard, and the teaching staff very strong. It has also a large Workshop attached, where the students are taught the different trades, which comprise (1) Carpentry and Pattern-making; (2) Fitting and Moulding; (3) Blacksmith's work and Boiler-making; and also receive a thorough knowledge of Machinery and the Steam Engine. Each branch is under a Foreman and a Native Instructor, the general supervision being under a Superintendent who is an Executive Engineer of the Public Works Department. On looking at the Prospectus of the Seebpore College, one is apt to imagine that it means all theory and no practice, which is the general idea, but a mistaken one, as the system in vogue with regard to examinations will show.

When a student of either branch enters the College, he is appointed to a shop, and is made to undergo a test examination at the end of his term in that shop; if he passes well and good, if not, he is kept back for another year and not allowed to try for his annual class examination; if he should happen to fail the following year, he is dismissed. The same course is adopted with regard to the class examination; so that the student must *really* work and study if he wishes to reach his final year in safety, and when he does, he must be worth something. Hence it may be inferred, that those who employ the Seebpore men will have their "money's worth"; but before doing so, it would be advisable to see that they have a *Passed* Certificate, and not a one or two year Certificate, as some, calling themselves "passed" students of the Seebpore College, only have. This is advised not only for the reputation of the College, but also to do justice to the harder working and more industrious students.

EX-STUD.

A NEW POST AND TELEGRAPH OFFICE FOR COLOMBO.—The new building will contain upwards of 70 rooms, and be three storeys high, and we understand that Sir Arthur Gordon has had a good deal to do with the drawing up of the plans, and takes an especial pride in the work, being desirous that the building should be worthy of Colombo, and some memorial of his stay in Ceylon. Its estimated cost is Rs. 2,00,000.



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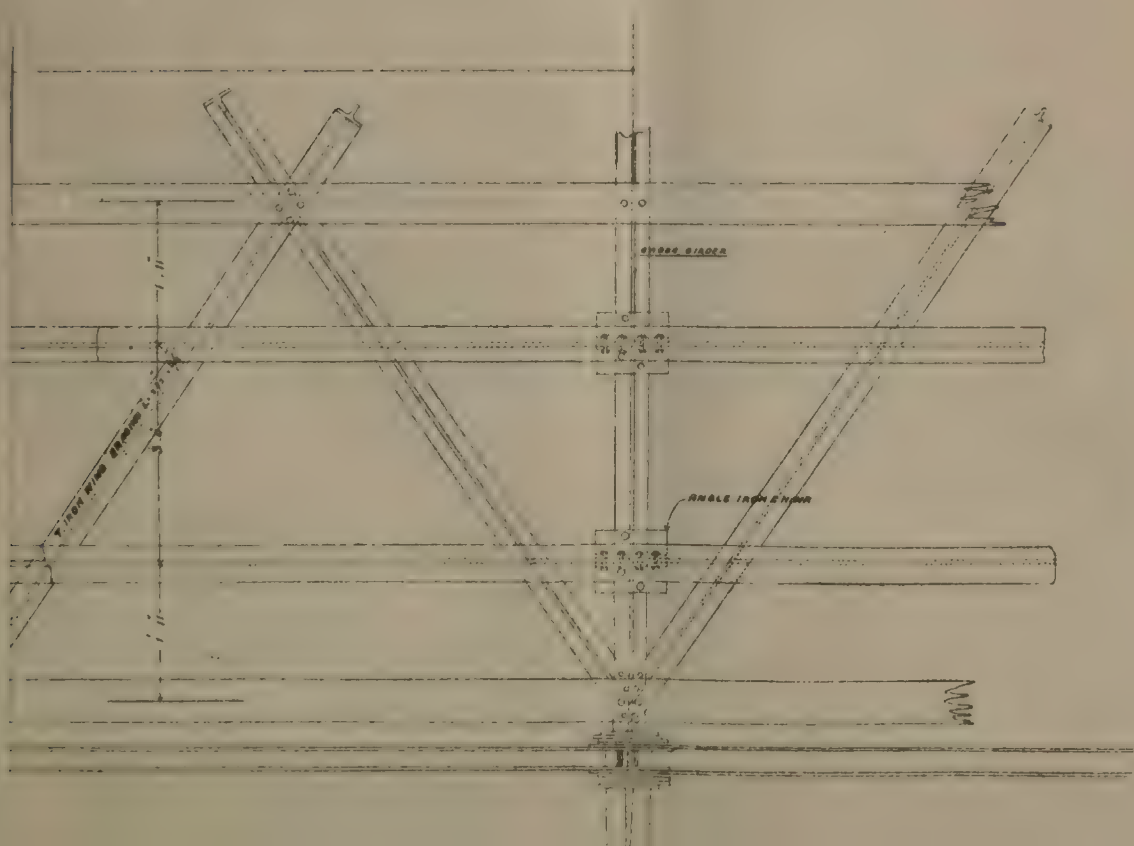

CROSS GIRDER
ANGLE IRON

NOTES FROM HOME.

[*Expressly for Indian Engineering.*]

Although there is not as yet any great improvement in business, still the prospect is getting more hopeful, and the coming year may see that development of trade which has been so long looked forward to.

As a set-off to the depression which has existed, we have had during the last year a wonderful activity in the way of Exhibitions, *viz.*, the Colonial in London and those in Liverpool and Edinburgh, and now we are to have, during the coming year, one in Manchester and another in Newcastle, while Glasgow is already actively bestiring itself with preliminary arrangements for an International Exhibition in 1888, a large and influential Committee having been formed of the leading citizens, the municipal authorities having taken the lead in the matter, and granted a site in the Kelvingrove Park for building. The Guarantee Fund has accumulated rapidly, until it now reaches about £170,000.

The shipbuilding on the Clyde, which has suffered largely owing to reduced demand for new vessels, shows some improvement, as a few new contracts have lately been fixed for new vessels, and various new vessels and torpedo craft are still building. The triple expansion engine is now *the* marine engine, and is being fitted into new boats, and gradually replacing the compound form in older vessels.

The saving effected in long voyages is considerable, the consumption per indicated horse-power per hour being much reduced, say, to something like 1½lbs. The steam pressures for such engines average from 160 to 200lbs. per square inch. Whether the advantages of expanison can be more widely extended seems doubtful, as any increase of the pressures above those named leads to some trouble through the rapid wear of the working parts exposed to the action of the steam.

The subject of forced draught in some cases the air being heated and the heating to a high temperature of the feed water by the waste heat in the chimney are engaging the attention of marine engineers.

Some interest is being exhibited at present in connection with the yachting challenge sent from the Clyde to the United States in respect of the "America" Cup, which has been attempted to be won back by the English yachts *Galatea* and *Genesta* against the *Puritan* and *Maybloom*. It is quite evident that as the style of American yacht and system of measurement is so different from British form there will remain much difficulty in getting the conditions equalized. The American yachts are broader and shallower than the British yachts, and have a much greater sail area, thus gaining a considerable advantage in light wind. From the fact that several of these centre board yachts have been upset in squalls it is evident that they have not the weatherly qualities of the deep and narrow British type.

Hydraulic transmission of power is being developed in some of our large cities, notably London, Hull; and Liverpool. The idea being from a centre or centres of pressure to distribute to consumers water power for working hoists or engines.

The use of oil for fuel is receiving attention for sea-going vessels, and it appears that under certain circumstances it can be efficiently and economically applied. Where coal is cheap the advantages, however, seem still to lie with the older combustible. The steam vessels on the Caspian use this fuel, which is abundant in the neighbourhood.

The defences of the Clyde have for some time engaged the attention of Local Authorities and of the War Office, and now a submarine defensive station below Greenock is about completed. This when finished will consist of a building on shore for stores of explosives and cables for electrical communication with the mines, &c. An iron pier of about 150 yards in length has been run out.

Soundings have been taken to ascertain the most suitable localities for laying the submarine mines. The Volunteers are to have the advantage of a special training here in laying and exploding of mines of this description. Forts to support this line of defence will be afterwards constructed at points on the coast.

The question of the satisfactory application of wrought iron or steel for water pipes of large diameters is engaging attention of engineers, the main difficulty being the question of corrosion. Experience of this action under such arrangements has not been long obtainable; still in a few cases such pipes have been laid successfully, and have stood the test for some years. When steel plates are used for this purpose the smooth surface presents additional difficulties, as the coating is apt to scale off by blows during transit; galvanized surfaces again are apt to be broken by rivetting.

Fog signalling by power has received an important impetus in the works recently finished at Ailsa Craig, a well-known isolated rocky islet rising to the height of about 1,000 feet at the entrance to the Firth of Clyde. A lighthouse and two sirens have been erected there, and the compressed air to the sirens had to be led in pipes for several hundred yards round the rocky cliffs of the island.

The great works at the Forth and Tay bridges are progressing slowly but surely, the shore spans of the former are being lifted into position by hydraulic power, as was done many years ago at the Britannia bridge across the Menai Straits in Wales and quite recently at the new works of the Tay bridge mentioned.

There is no special feature about the Tay bridge, unless its great length as a viaduct, about two miles. The Forth bridge, however, is a gigantic enterprize, the design consisting mainly in two large spans of 1,700 feet, each of the cantilever form of girder, the extreme height to top from water level being about 300 feet.

Cantilever bridges have been tried with success in America and appear to be economical of material when the spans are considerable. One great advantage is that they can be erected without staging or scaffolding, hence their suitability for deep ravines or turbulent rivers.

BURMAH.

(*From Our Own Correspondent.*)

The late visit to this Province of Sir Theodore Hope (Public Works Member in the Viceroy's Council). and followed shortly by that of General Chesney, augurs well for the future of Burmah. Their visits and inspections have led all to believe, that we may shortly see our railways and communications by land and water extended throughout the Province. The surveys of the whole line from Mandalay to Toungoo are now completed. Mr. J. M. Salmond, Executive Engineer in charge of the first construction division from Toungoo to the 30th mile, is fast pushing on with the earthworks and Mr. R. C. Beetson, Executive Engineer, second division, has charge of the remaining running to Ningyan, a distance of 29½ miles; while Mr. S. C. Bageley is working downwards from Yemethen to Ningyan. Mr. F. L. Diblee, Executive Engineer, is pushing on the work of 11½ miles from Mandalay to the south bank of Myitinge-chaung. We have gathered from a minute of a great authority that the whole line will take three years to complete, and in consequence of the difficulties in working the line from Mandalay to Yemethen (the country being net-worked by rivers and streams), all the available staff of Engineers from India are being brought to the Province to expedite the work of the railways.

Irrawaddy Flotilla Co., Ld.—This enterprising Company is rapidly increasing their fleet of steamers. Last month the S. S. *Dufferin* was launched with the permission of our reigning Viceroy, in whose honor the vessel was specially built and named. She is a two-decked paddle boat; her dimensions are 310 × 40 feet; her gross tonnage is 1,033 tons; her engines and boilers are by Messrs W. Denny and Brothers, compound direct-acting diagonal of 375 horse-power; her steering gear, capstans and winches are all worked by steam, and she is fitted with all the latest improvements for a vessel of her description. The panels of the cabin are satinwood, fitted in handsomely carved teak, worked at the Industrial Art Institute, Rangoon. There are a number of larger and smaller steamers now on the stocks, which are being fitted out for light draught for the rivers in Upper Burmah. We may here mention, that a gentleman well known in this port, Mr. Gillespie, has been sent out by a wealthy Syndicate at Home, to sell shares to the inhabitants for the purpose of starting a rival fleet.

The Port Trust are now erecting a very ingenious and portable crane. It is very handy, and admits of a large quantity of work being got through in a short time. This crane, capable of dealing with 10 or 12 cwt., weighs only 15cwt. carriage and all complete, only occupies a space of about 6 feet × 3, while the double jib arrangement prevents any loss of time, for as soon as the load is released from the one end, or jib, the loading commences at the other end. It can also be altered into a single jib in a moment, and in either case, has all the movements of an ordinary crane. The carriage is fitted with five wheels—three before and two behind. By screwing down the centre front wheel, the carriage is converted into a three wheeler, thus permitting it to be steered in any direction.

Miscellanea.

TEXTILE AND FACTORY TOPICS.

This season's cotton crop is not expected to be larger than the last, and it is probable even with a late fall, the crop will be smaller.

The Australian Chambers of Commerce appear dissatisfied with the present practice at the London wool sales by half-penny "bids." South Australian stockbrokers say that on low-classed wools, the advance of a half-penny often means a rise of 12½ per cent. which they think excessive, especially when the usage at cotton sales is considered.

The cultivation of cotton has recently made much progress in the Caucasus, particularly in the Government of the Erivan. There is much uncultivated land left, well adapted for raising this most useful crop.

Vice-Consul Longford makes some startling assertions respecting the ignorance of British manufacturers of the real requirements of Japanese consumers, asserting that they are not one single step further towards a knowledge of the *bonâ fide* Japanese commercial classes than they were one year after the country was ever opened to them.

Consul Woolridge equally complains that the manner in which business has been and is carried on in Catalonia (Spain), by English merchants in England, is wholly against success.

The *Textile Recorder* remarks, that in no other country are cotton mills so heavily taxed than in Italy, *viz.*: a rate representing 6·7*d.* per spindle; thus 100,000 spindles pay yearly, £2,800 tax.

The same organ in an article on the "Indian Cotton Industry," repeats that the cotton spinning and weaving industry is chiefly centred in the Bombay Presidency, though there are a few mills in other provinces also, while the jute manufacture is confined to Calcutta and neighbourhood. The cotton mills of India now employ 16,492 looms, 2,037,055 spindles, and the jute mills 6,926 looms, and 131,740 spindles. Since the removal of the import duty of 5 per cent, on cotton goods from other countries to India, cotton industries have been seriously injured, and the markets thrown open to Germany and America, while England has not benefitted.

The displacement of manual processes by machinery is probably the most noticeable feature of the last 50 years, and in manual feeding of wool or other fibrous materials, there was an obvious field for improvement. A very ingenious invention carrying out this improvement is Lemaire's patent feeder for wool or worsted cards, as made by Mr. Som. Brooks, of West Gorton, Manchester.

Messrs. Erskine and Finlay, of Wolf Hill, Antrim, have patented improvements made by them in rollers for wet spinning frames, which are fully described in the last number of the *Textile Recorder.*

Experiments, which have been made in Guatemala with rhea fibre, are stated very successful. This result can but give an impetus to its cultivation, already developing on the South Coast of the Pacific. The Favier machine for separating the bark, and afterwards washing away the gums, has also been improved upon by a Belgian inventor, and the fibre produced by this machine is stated to be of excellent quality.

According to *Industries*, a new process of dyeing is about to be introduced in Roubaix, the reputation of whose goods will be materially advanced by this discovery.

Mr. Cant (Wood-turner of Dundee), has improved spinning, roving, winding and other bobbins, by preventing the splitting of bobbin heads and the wearing of driving holes. A groove is cut in the bobbin head, and a metallic ring being therein inserted, splitting is impossible.

A correspondent to the last-named organ suggests dispensing with the overhead motion in our cotton mills by substituting compressed air.

The sale of the spinning and weaving machinery, which Messrs. Marshall and Co have until recently used in their flax business at Holbeck, occupied five days. They are transferring their business to the other side of the Atlantic in Jersey city.

TECHNICAL AND SCIENTIFIC ITEMS.

A French inventor proposes to use electricity for bleaching pulp.

Wokingham has given up gas in favour of oil for lighting the town!

An exhibition of telephony is to be held in Brussels at the beginning of next year.

The microphone is now being used in Germany for the detection of loss of water through mains.

The promoters of the Channel tunnel scheme, intend to apply for additional parliamentary powers.

The Hungarian Government is contemplating a large development of agricultural and portable railways.

It is proposed by the Russian Government to construct a railway connecting Russia with China, even penetrating to the capital.

The German papers state that by means of electricity an article has been produced by which any kind of leather may be successfully imitated.

According to *Iron*, it is a mistaken idea that charring timber promotes its durability, for experiments have shown that charring leads to premature decay.

The Italians have set up a Chamber of Commerce at Paris, and attached to it is a pattern for the display of Italian goods likely to suit French consumers.

The largest piece of wrought iron weldless pipe yet made (28 feet long, 8 inch diamater, and weighing 650lbs.) has been turned out by the American Tube and Iron Works, of Youngstown (Ohio.)

A new application of pneumatic power is being adopted by the French Minister of Posts and Telegraphs, which consists in winding up the weights of the Hughes printing telegraph by compressed air.

Dr. Jorrissen, a member of the Transvaal Government, is delivering lectures in Holland, with the object of inducing Dutch capitalists to construct a railway to Delagoa Bay, so as to counteract English influence there.

Messrs. Douglas and Grant (of Kirkcaldy, N.B.), than whom probably no engineer has done more to introduce Corliss engines in this country, have been awarded the gold medal for this class of work at the recent Edinburgh Exhibition.

The Great Northern Railway Co. are erecting a new roof at their King's Cross terminus. Messrs. Handyside and Co., of Derby, are the contractors for the work—estimated at £80,000—which is a sufficient guarantee for the soundness of the job.

We agree with the *Mechanical World* that it is unjust to unsuccessful *bonâ fide* tenders to saddle them with heavy charges frequently made on copies of specifications, for equity certainly demands that in such cases fees so paid should be returned.

The great harbour works, now in course of construction at Boulogne, bid fair to form a far more practical and practicable link in the means of intercourse between France and England, than could have been afforded by the Channel tunnel.

If the trial of the "Hope Gun," invented by Mr. F. J. Hall, prevents the prevention of erosion, and turns out satisfactorily in other respects, it is stated that Messrs. William Jessop and Sons (Brightside Steel Works, Sheffield), will go in for the manufacture of ordnance.

The Belgian authorities have abandoned the idea of holding an international exhibition of military and naval appliances, in Brussels, in 1888. It is now proposed to set on foot an international, industrial, and scientific exhibition, but this idea is meeting with much opposition.

A scheme has been prepared by Messrs. John Lanyon, C.E. and W. J. O'Neill C.E., both of Belfast, for controlling the flood levels of the Lough Neagh, Lough Beg and the lower and upper Rivers Bann, to prevent flooding of the adjacent lowlands. The cost is estimated at £57,500, and the area to be drained exceeds 25,000 acres.

Interesting experiments on the utilisation of wave power, are being carried out at the beach, near San Francisco, it being the ultimate object to supply the city with 5,000 to 6,000 horse power for industrial purposes, in place of steam power. The idea is to raise the sea water through the medium of a pump operated by the wave-action, to a height of about 350 feet, whence it can be directed into the city and its fall used for driving purposes.

The Russian Government is engaged in one of the most extensive drainage schemes ever undertaken, larger in area than the whole of Ireland. The location is what is known as the Pinsk marshes. Up to the present time 4,000,000 acres have been reclaimed, comprising several thousands of miles of ditches and canals, 179 bridges, 577 bored wells, and a survey of 20,000 square miles of country hitherto unmapped.

Iron observes that but little is as yet known of the actual economic performances of compound high-pressure non-condensing engines, which has induced Messrs. Davey, Paxman, and Co., of Colchester, to make an exhaustive trial on one of their 40 horse-power semi-fixed compound engines at the late Colonial and Indian Exhibition. The results fully detailed in *Iron*, in its opinion, redound to the credit of the Colchester firm, whose reputation it cannot fail to enhance.

As railway construction in England becomes more queiscent for reason that there is little room left for extension, our Colonies, writes *The Builder*, take up the running vigorously, and open up fresh fields for engineering talent. Canada, in special, has, in proportion to her population, built already more railways than any other nation in the world. No sooner was the Canadian Pacific open, than it is followed by a new undertaking, that of the Hudson's Bay Railway, which will be of immense importance as a supplier of bread and meat stuffs to this country.

The theatre of the University College, Newcastle, was lately the scene of some important experiments with miners' safety lamps, to test their capabilities, in dangerous air currents. The Morgan lamp could not be exploded after several trials by the inventor and others. The Gray lamp exploded in 10 seconds; the Evan Thomas lamp exploded in 10 seconds; the bonneted Mueseler was not exploded in the first trial, but exploded in 10 seconds in the second trial. The Ashworth Davis was not exploded. Marsant A (two gauzes) was not exploded in 1½ minutes' trial, but on a second test it exploded in 30 seconds. The Marsant (from Clayton Cross Colliery, two gauzes), exploded in 35 seconds. Clifford's lamp was not exploded after trial.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, 25th December—

18th December.—Lieutenant O. M. R. Thackwell, R.E., Assistant Engineer, 1st Grade, *sub pro tem.*, N.-W. P. and Oudh, temporarily emloyed on State Railways, is transferred permanently to State Railways, and posted to the Establishment under the Director General of Railways.

22nd December.—Mr. J. Mackenzie, Honorary Assistant Engineer, 2nd Grade, Punjab, is transferred to Burmah.

23rd December.—P. W. D. Notification No. 342, dated 4th December 1886, transferring Lieutenant-Colonel E. N. Peters, R. E. Executive Engineer, 1st Grade, to Burmah, is cancelled.

Burmah 11th December.

7th December.—Mr. T. E. Owen, Executive Engineer, 1st Grade, reported his arrival at Rangoon on the forenoon of this date.

Mr. Owen's services are placed at the disposal of the Engineer-in-Chief, Burmah State Railway.

In anticipation of the sanction of the Secretary of Sate to the construction of the Toungboo-Mandalay (State) Railway, and with the approval of the Government of India, the Chief Commissioner sanctions the appointment of Mr. F. L. Dibblee, Executive Engineer, 1st Grade, to the charge of the Mandalay division, extending from the Mandalay railway station to the south bank of the Myitnge chaung, a distance of 11½ miles, with head-quarters at Mandalay. This appointment to date from the 15th November 1886.

10th December.—Mr. H. J. Richard, Executive Engineer, 1st Grade, is appointed Superintendent of Works, Upper Burmah, from the 1st January 1886.

N. W. P. and Oudh, 28th December—

BUILDINGS AND ROADS BRANCH.

24th December.—The following officers will form the Engineering Establishment of the Rohilkhund and Kumaun Division:—

ROHILKHUND.

Divisional Engineer.

Mr. J. W. Alexander, Executive Engineer, 1st Grade.

District Engineers.

1. Mr. R. C. Battie, Executive Engineer, 2nd Grade, Bijnor.
2. „ J. H. P. Forsyth, Executive Engineer, 4th Grade, Moradabad.
3. Mr. R. D. M. Lang, Assistant Engineer, 1st Grade, Bareilly.
4. „ E. A. W. Phillips, Assistant Engineer, 1st Grade, Budaun.
5. „ S. Peart, Honorary Assistant Engineer, 1st Grade, Shahjahanpore.

KUMAUN.

Divisional Engineer.

Mr. F. H. Ashhurst, Executive Engineer, 2nd Grade.

Honorary Lieutenant P. J. Ryan Asst. Engr, 1st Grade, Naini Tal.

District Engineers.

Mr. L. B. Simeon, Exec. Engr, 4th Grade, Mr. J. Thornhill, Asst. Engr, 1st Grade; Mr. R. J. Powell, Asst, Engr, 1st Grade, Special Temporary Sub-division, Ranikhet Road.

The following officers are transferred :—

Mr. C. J. Sheridan, Executive Engineer 2nd Grade, lately Sub-divisional Officer, Moradabad, to Meerut Provincial Division.

Mr. A. H. Ashton, Assistant Engineer 1st Grade, Sub-divisional Officer, Bareilly, to Allahabad Provincial Division.

Irrigation Branch.

18th December.—Mr. C. A. T. Dodsworth, Executive Engineer, 4th Grade, *sub. pro. tem.*, is, on return from medical leave, posted to the Anupshair Division Ganges Canal, *vice* Mr. S. Athim, Assistant Engineer, 1st Grade, transferred to the Bulandshahr Division Ganges Canal.

Assam, 18th December—

11th December.—Mr. R. E. Nelson, Executive Engineer, 2nd Grade, reported his arrival at Dhubri on the afternoon of the 27th November 1886.

Lalla Brij Mohan, B.A., C.E., Assistant Engineer, made over, and Mr. R. E. Nelson, Executive Engineer, received, charge of the Office of District Engineer, Goalpara District, on the afternoon of the 1st December 1886.

Madras, 21st December—

The following posting is ordered :—

Mr. W. C. Lewis, Assistant Engineer, First Grade, to the Tank Maintenance Scheme, for duty in No. 11 Tank Division.

Bombay, 23rd December—

Railway.—Captain J. Burn-Murdoch, R. E., Officiating Deputy Consulting Engineer for Railways, passed on the 8th December 1886 the examination in Hindustani according to the Higher Standard as laid down in Rules V and VI of the General Order by the Government of India No 734, dated the 9th September, 1884.

Bengal, 29th December—

Establishment—General.

28th December.—Mr. W. A. E. Hanby, Assistant Engineer, 3rd Grade, is transferred in the interests of the public service from the Calcutta to the Western Circle.

With reference to Bengal Government Notification No. 426 of the 10th instant, Mr. F. Sills, Executive Engineer, 2nd Grade, is attached to the Office of the Superintending Engineer, Eastern Circle, as Personal Assistant to the Superintending Engineer. Mr. Sills took up the duties of his appointment on the afternoon of the 15th instant.

Establishment—Irrigation.

28th December—Posting.—With reference to Bengal Government Notification No. 433 of the 8th instant, Mr. M. J. Monckton, Executive Engineer, 3rd Grade, is posted to the Arrah Division, which he joined on the forenoon of the 15th idem.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

4th December 1886.

79.—Edward Schmidt, Railway Inspector, residing at Zimmersrode Kingdom of Prussia, German Empire.—*For improvements in railway sleepers.*

42.—James Brown, of 11, Seacome Street, Liverpool, in the conty of Lancaster, England, Engineer, and Thomas Andrew Porter, of 39, Chesnut Grove, Bootle, also in the county of Lancaster, England, Advertising Contractor.—*For an improved means of and apparatus for climbing chimneys, shafts, columns, steeples and the like erections*

107.—The Cassel Gold Extracting Company, Limited, of 157, West George Street, Glasgow, Scotland.—*For an improved process and apparatus for treating metals, alloys and especially auriferoas ores by electrolysis.*

131.—George Bronnen, Fellow of the Chemical Society, of No. 15, Althrop Road, Upper Rooting, in the county of Surrey, England.—*For the preparation of extract and beverages from the leaves of the cocoa plant.*

140.—William Hood Gilruth, Planter, Ceylon, late of Assam.—*For separating, sorting and twisting bruised and rolled green tea leaves.*

162.—Henry Bull, of Epsom, in the county of Surrey, in England, and of Serampore, near Calcutta, in the Empire of India, Brick Manufacturer and Contractor.—*For an improved and more economical method in the formation of brick kilns, and of burning and manufacturing bricks, tiles and other goods.*

185.—John G. Dobbie, Engineer, 14, Bridge Road, Mazagon, Bombay.—*For ascertaining and verifying the immersion and corresponding displacement of steam and sailing ships.*

204.—Albert Marcius Silber, of Wood Street, Cheapside, in the City of London, England.—*For an improvement in overhead Lamps.*

205.—Everard Richard Calthrop, of Malabar Hill, Bombay, Locomotive Engineer, Great Indian Peninsular Railway.—*For means of holding window and louvre sashes for railway carriages and other vehicles.*

11th December 1886.

48.—James Henry Barber, of Blackstone Tea Estate, Ceylon.—*For improvements in rolling tea leaves in the manufacture of tea.*

104.—Peter William Fleury, of 93, Lower Circular Road, 24-Pergunnahs, Bengal, India.—*For a method of working dynamo-electric light machines by an improved manual-power motor adapted to India.*

112.—Chaimsonovitz Prosper Elieson, England, Electrician.—*For improvements in electrical accumulator or storage batteries.*

196.—Charles Ashburnham Floyd, of Eastbourne, in the county of Sussex, England.—*For an improvement in hansom cabs.*

201.—Alexander Douglas Larymore, Deputy Inspector-General of Jails, Bengal, and at present a resident of Alipore, near Calcutta.—*For the poor man's punkah chair and baby's punkah cradle.*

212.—Ralph Smith Jennings, of Baltimore, Maryland, United States of America.—*For improved means and apparatus for effecting the drying of articles of merchandize or for like purposes.*

SELECTED ABSTRACTS OF RECENT INDIAN SPECIFICATIONS.

Working Dynamo-Electric Light Machines.—104 (1886).—*Peter William Fleury.* The machine consists of two driving shafts with four crank handles turned by manual labor. The two first shafts have driving wheels with teeth which work two other loose toothed wheels which turn loosely on two studs; these toothed wheels or carriers give motion to a small pinion or toothed wheel. On the shaft of the pinion wheel is fitted a large size heavy fly-wheel with outter rim turned true. From this fly-wheel motion is conveyed to a small pulley of the dynamo-electric machine by means of a leather band, the armature of which machine turns at the rate of 1,600 revolutions per minute. The advantage gained by the above arrangement of having a heavy fly-wheel fixed on the last shaft of the train of wheels is that the fly-wheel acquires a great momentum owing to its heavy weight and great velocity, and it thus becomes a storer or accumulator of mechanical energy. The machine is thereby better enabled to overcome the sudden unequal resistance caused by the powerful electric current and magnetic attractions in the dynamo-electric machines. The whole apparatus is substantial, cheap and portable, and when fixed on wheels can be drawn by two coolies. It is well adapted for the following purposes: searching for an enemy in time of war; lighting up a camp at night or throwing it into darkness; instantly if required striking or pitching a camp at night; assisting troops embarking and disembarking or crossing rivers or swamps at night; signalling at night with the ordinary Military Code or adapting it to a heliograph at a small cost; exploding mines hastily constructed to destroy earthworks, forts, buildings, &c., with perfect safety to the exploding party; firing torpedoes in naval warfare; lighting up band stands, evening garden parties, *fêtes*, durbar halls, &c.

Improved Soorkee Mill.—210 (1886.)—*Charles Sheppard.* The object of this invention is to provide more efficient means than at present exists for reducing bricks or brick ends to powder called soorkee, and for reducing other substances to be pulverized. The brick ends or other substances to be reduced are fed through a hopper into

a cylindrical chamber on to a rapidly revolving plate. This plate has a number of blocks or hammers firmly rivetted to it, at suitable distances apart on its upper surface, and is surrounded by a cylindrical grating formed of iron or hard steel bars, placed at the required distances apart from each other, according to the degree of fineness to which it is desired to reduce the material, so that on the substance to be pulverized being fed through the hopper it falls on to the revolving plate, and is there met by the blocks or hammers rivetted to it, and forcibly driven against the iron or steel bars forming the grating. All the material that is broken fine enough by the first blow to pass between the bars escapes, and that portion which is not broken fine enough to pass the grating by the first blow from the revolving blocks or hammers falls back on to the plate, and is returned over and over again by the action of the blocks or hammers until the whole of the material has been pulverized and driven through the grating into the chamber suitably formed to allow of its removal.

Extracts.

DEHRA DOON RAILWAY.

IN April last the Government of India, in the Public Works Department, in addressing the Local Government on the subject of the proposed Railway from Hardwar to Dehra and Rajpore, suggested that as a Railway to the Doon was in itself desirable whenever financial arrangements for its construction might be practicable, irrespective of whether the Association who have during the last three or four years been working towards that end might be able to undertake it or not, His Honour the Lieutenant-Governor should take advantage of the first convenient opportunity to depute an officer to go over the ground and report practically on the project. And subsequently, after receiving from the Association a revision of the project, which greatly improved the gradients, and considerably reduced the cost, the Government of India said to the deputation that went to Simla last July that they would not be in a position to say anything more on the subject until they should have received the report of the examination of the line by the officer to be deputed by the Government of the North-Western Provinces and Oudh for the purpose, with the remarks of the Local Government thereon.

We hear that the Local Government have now intimated to the Association that Mr. E L. Hunt, Executive Engineer, has been deputed to go over the line and report upon it, and that he may be expected at Hardwar for that purpose during either the last week in November or the first week in December. It has also been announced that after receipt of Mr. Hunt's report Major Gracey, R.E., the Assistant Secretary to the Local Government, P. W. Department, will pay a flying visit to the line, and confer with the promoters.

The questions of the probable cost of constructing the railway, and of the amount at which the working expenses ought to be estimated, as to both of which there has been much controversy between Government and the Association, ought, therefore, soon to be settled and an agreement will then be possible as to its prospects of net revenue. As to the probable amount of gross revenue we hear that there never has been any controversy among those consulted.

DISTRICT TRAMWAYS IN BENGAL.

THE idea of opening up the interior of the country by means of tram lines first originated with the government of Sir Rivers Thompson. It was at the instance of Lieutenant-Colonel Neill, as Under Secretary to the Government of Bengal in the P.W.D., that the Road Cess Committee of Hooghly opened its eyes to the wisdom of accepting the principle, and sanctioning a particular scheme for the construction of a light railway on the Juggutbullubpore road in the Howrah district. The project has stood over for reasons that are not to be regretted. The subject has now to be disposed of by the District Board of Howrah, which has acquired independence as a local authority under the Local Self-Government Act. A similar scheme has been started by the people in the district of Hooghly, and is making rapid progress. It is a movement exactly in harmony with the more manly aspirations to which the Indians as a nation are awakening. The projectors of the Howrah-Seakhal Tramway should be congratulated upon the results that have attended their efforts in securing shares, if what we hear be a fact, that native capital to the extent of a lakh and thirty thousand rupees has been promised, with a tendency to rise to a much higher amount. Indeed, it is eminently desirable that they should be able to prove the undertaking a purely indigenous enterprise. If they can, this would give a new start to the national life of India, or of Bengal at any rate. Other districts, finding such a thing possible, will no doubt in rapid succession follow it. The promoters, we understand, are now engaged in getting up their application for the local authorities to consider, and it is said they will form themselves into a joint stock company in going up to Government for final sanction. We ought to be reluctant to anticipate any difficulties in obtaining the unanimous consent of the District Boards of Hooghly, Howrah, and the Municipal authorities, who are all concerned.

BRADFORD LESLIE.

THE *Statesman*, in noticing the completion of the Hooghly Bridge, refers to the many successful engineering works of Mr. Bradford Leslie, —so numerous that no one can scarcely arrive at, or leave the city, without being reminded of some of the works in which he has been engaged and carried out successfully. And our contemporary remarks:—"Such is Mr. Bradford Leslie's retiring nature, that, in spite of his distinguished services, he is probably known to few of our readers by name, and to hardly any even by sight. He is a citizen to be proud of nevertheless." Yes—this is the case, undoubtedly; and yet, beyond the two simple letters C. E., Mr. Leslie makes no demand upon the alphabet. He is not found among the Stars of India that twinkle for a brief space, scarcely known and soon to be forgotten. Men who hardly know a Railway chair from a *charpoy* may be exalted to the firmament, and on the strength of their ignorance, rather than their knowledge, are exalted, and are supposed to shine for a brief period, though doomed to a sudden and complete eclipse that will never pass away. But plain "Bradford Leslie", —a name that is often honoured by the omission alike of conventional prefix or affix—will live enshrined in the hearts of the people who sing of "Leslie *puls*," and will transmit his fame to their children. In their estimation he is greater than their gods. He has bridged the unbridgable Mother Gunga, and thousands came and wondered to see the marvellous work. Native bards threw their wonder into song, and from Calcutta to the source of the Gunga the name of Leslie is as that of one, and that not the least, of India's pantheon. Strange that the "common people" should have a higher appreciation of the work and the merits of such a man than those who might be supposed to know and to recognise the services such men perform. Possibly, the innate modesty of Mr. Leslie, of which our contemporary speaks, may have led him to decline offers of alphabetical distinctions beyond that which he bears in virtue of his profession. He has been a successful man, and besides his own ability he has known how to select men to carry out his plans. It would be well for the country if a similar conjunction of faculties were found in the administration. The alphabet is a poor substitute.

PAPER MAKING IN HONG-KONG.—We hear from a Chinese source that preparations are being made for starting a large paper-work near Shau-ki-wan. A manager has been obtained from Shanghai, and already considerable purchases of ground have been made. The works are to be carried on, it is said, by a company, the shares of which have been already largely taken up by the wealthier Portuguese and Chinese Hongs. Building operations will be begun in less than a month.

Notices.

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CONTENTS.

Answers to Correspondents.

E. E.—Opinions differ, and we are neutral. The Kosi bridge in question is an "India Office" design.

Several matters are unavoidably held over for want of space, but as we appear *weekly*, we hope to soon clear them off.

Obituary.

LOWELL—At Ajmere, Charles Lowell, for many years of the Locomotive Department, Rajputana-Malwa Railway. (Deeply regretted.)

WADIA—December 15th, at Mr. Jamsedjee Bomanjee Wadia's residence, Byculla, Dadabhoy, son of Framjee Rustomjee Wadia.

INDIAN ENGINEERING.

SATURDAY, JANUARY 8, 1887.

INDIAN TELEGRAPH DEPARTMENT.

OF all the branches of administration under the Indian Government, the Post and the Telegraph departments have attained a state of efficiency of which any European nation might well be proud. The fame of their management, which has effected such glorious results, has spread to the Continent, and it was a well-merited compliment which Germany paid us when she sent an expert to enquire into the system on which the postal service is worked here, and to take home a few "wrinkles" for the benefit of the Fatherland.

The Telegraph service has, of course, been inaugurated more recently, but the huge proportions to which it has developed in respect of the enlargement of the area of its operations, the increase in traffic and revenue, and in both the speed and accuracy of transmission, conclusively prove the soundness of the policy which has guided the Department. Its advantages have been clearly placed before the people of the country, who have not been slow in profiting by the extension of lines to the centres of native trades and industries. There has been scarcely a single year in which these returns have shown a tendency to abate. On the contrary, they have gone on steadily advancing with leaps and bounds. It is, therefore, gratifying to find from a Resolution of the Government of India published last week that during the year 1885-86 the progress made by the Department was admirable, as will be apparent by consulting the following figures. The length of lines was increased by 2,123 miles of new lines, making a total of 27,510 miles. The length of wires was increased by 6,507 miles to a total of 81,480 miles, and the number of new offices opened to the public was 176. On the other hand, the number of messages sent from Departmental offices only was 2,289,938, showing an increase of 274,841 (above 60 per cent. of these being Inland Private telegrams) or more than 13 per cent. over the number for the previous year; and the total receipts from the despatch of telegrams amounted to Rs. 39,61,052, an increase over the previous year of Rs. 4,63,025. This sudden large augmentation of Message Revenue was in part due to the events on the North-West Frontier at the beginning of the year, and the Military Operations in Burmah during its close; still, the receipts from the Inland Private traffic was satisfactory, being Rs. 16,38,000 or Rs. 1,33,000 more than in the previous year. The falling off in the receipts from Foreign Private telegrams is very properly attributed to the steady decline in the value of silver. Comparing these figures with those for 1883-84 we observe that the length of lines has been increased by 17·9 per cent., the number of offices by 27·7 per cent., and the revenue from Messages only (excluding those sent from other than Departmental offices) has risen by 23 per cent., while the working expenses have also diminished by 3·4 per cent. during the past three years.

The initiation of two important reforms—the opening out of offices worked by extra Departmental Agency, in connection with the Post Office, and the system of "deferred telegrams"—has contributed in no small degree to the effective working of the present system, and to the great relief invariably afforded to the offices and lines. The former constitutes two-thirds of the agency employed, and the latter contributes 63·15 per cent. of the entire traffic—thus marking an era in the development of the Department. Since 1881-82 the number of Departmental offices has been nearly doubled; the gross revenue has risen from Rs. 38,54,212 to Rs. 51,10,986 in the year under review; the charges against Revenue Account have increased from Rs. 32,35,644 to Rs. 36,18,695 only, and the nett revenue from Rs. 6,18,568 to Rs. 14,92,291. The Capital expenditure at the close of 1885-86 was Rs. 3,83,16,760, of which about Rs. 29½ lakhs was expended during the year.

At the ordinary quinquennial International Telegraph Conference held in Berlin in 1885, India was ably represented by Colonel Sir J. Bateman Champain, R.E., Director-in-Chief of the Indo-European Telegraph Department, assisted by Mr. C. H. Reynolds, a Superintendent. Among other concessions the reduction of rates on messages between India and the United Kingdom was from francs 5.60 to francs 5 per word, or from 4*s*. 7*d*. to 4*s*. as levied in the United Kingdom. "The continued heavy fall in exchange," says the report, "has, however, prevented the Indian public from benefiting by a reduction which was obtained with considerable difficulty by India's representatives, and the only satisfaction so far gained by it in India is, that it has rendered unnecessary any material increase over former rates. The position of this country in this matter will be understood when it is stated that the international tariffs are all calculated in effective francs, *i.e.*, francs in gold, in the equivalent of which all obligations with other countries have to be settled. It is evident, therefore, that the public must pay more in depreciated rupees for telegraph services valued in gold in proportion as silver falls in comparison with gold in the world's markets."

With such a large increase of business as we have adverted to above, the workshops were fully employed during the year, and the erection of new buildings gave a great impulse to the endeavours of this Department to substitute articles of local manufacture for those hitherto imported. In this connection we would invite the notice of capitalists in this country to certain significant facts disclosed in the Report on Workshops and Stores. Of the stores purchased during the year under notice about 15 lakhs were expended on articles of foreign manufacture, including freights and landing charges, while stores purchased here cost only two lakhs. Here is a wide field for investment, which is thoroughly neglected by Indian enterprise, especially in the case of goods the materials for which are ready to hand, and which have to be imported, at a heavy outlay, to England and the Continent. We merely throw this out as a hint for the benefit of those who may desire to enter into a safe competition and who would thereby materially help to develope the resources of India.

ATTITUDES OF INDIAN WORKMEN.

In the course of a post-prandial speech at one of the entertainments given to the Institution of Mechanical Engineers and their Belgian visitors, at the meeting held in London in August last, the President created some amusement by making a comparison between the attitudes of English and Indian mechanics when at work. An English engineer-apprentice, he said, thought not a little of his skill and prowess, when he was able to chip and file, truly and expeditiously; the work operated upon being held firmly in a vice, beside which he himself stood erect, on a firm and level floor. He would, however, advise any such self-sufficient apprentice to go to the Indian and Colonial Exhibition at South Kensington, and there watch for a time, as he had done, the much more skillful, and therefore much more meritorious, way in which the Indian metal-worker did his work. He was filing the exterior surface of a small brass cylinder, closed at one end and open at the other; in form something like a drinking glass. He made use of no such rough and rude implement as a steel vice to hold his work, for that might have flattened or distorted it. Besides, after a stroke or two with the file, there would have been the irksome necessity of slackening, turning, and gripping again. Our Indian fellow-subject had a better plan than that. He sat on a mat with his legs drawn up in such a way that the inner surfaces of his knee joints were on either side, in close proximity to his auditory organs; whilst his arms hung externally to his nether limbs. Four of the digits of his naked left foot were inserted into the open mouth of the brass cylinder, lying as it did, horizontally on the mat; where the fifth or largest one gripped it from the outside. Here was a natural vice; and one which the user had the power of relaxing and re-tightening at each stroke of the file; besides giving the work that slight rotary movement or "feed forward" which would obviously be necessary. Now he invited each and all of their younger members, (he would not suggest the older ones), when next they found themselves in the retirement of their private chambers, to see whether they could place themselves in the position he had attempted to describe even without doing any work at all. And if, as he strongly suspected, they could not, then he thought he might fairly ask them to think less of themselves, and more of those Indian artificers, whose work was so much admired, but whose modes of operating had hitherto been so little known in this country.

THE PLEA FOR IRRIGATION WORKS IN MADRAS.

The old question of canals *versus* railways has been revived by General Rundall at Home by a Paper on the "River Systems of Southern India," wherein the action of the British Government in not doing all it should in respect to the extension of irrigation in that part of the Peninsula is severely commented on and exposed. The issue of the relative advantages of land communications and agricultural improvements is, we think, beside the question, as to our view "the railway" is of the greater importance to the country, whether from the stand-point

of famine protection or material benefits at large. Those who hold up the Cauvery, Kistna, and Godaveri systems as examples of the immense value of irrigation works, forget that the benefits are only local, and due to favourable circumstances of a special nature—to wit, deltaic areas—which do not always obtain. By this we do not mean to depreciate the labors of Sir Arthur Cotton and others on the systems named, but we must certainly deprecate undue assumptions and wrong conclusions with respect to the same.

Again, the Tongabudra project is always brought forward as a scheme that might accomplish wonders, while the total failure of the late Madras Irrigation Canal Company and the existence of that "white elephant," the Kurnool-Cuddapah Canal, which derives its source from the Tongabudra river, is innocently ignored. It is unjust to the Madras authorities to say that they are not sufficiently alive to the importance of turning to account the available waters of its many rivers. We need only refer to the Lower Coleroon, Rushikulya, or Sungum projects to upset the charge. Nor have the Madras authorities been negligent in regard to what the opposition designate as " the storage embankment of water." The Tank Maintenance Scheme shows that it has acted on the wise principle of restoring and preserving existing reservoirs—in completing and perfecting rather than launching into fresh, costly, and, perhaps, dubious undertakings.

There can be no doubt that irrigation can do much towards rendering certain localities independent of the seasons, but the fact remains that railways can do more towards mitigating scarcity as a means of transporting food from localities where it is in abundance to where it is wanting. The possibilities on this head were fully demonstrated in the instance of the Madras famine, which cost ten millions sterling and four million lives, and which might have been prevented had the railway system of the country been developed as rapidly and largely as it deserved.

THE LAHORE TRAMWAY.

THE success of all public undertakings depends mainly upon the working capability of the directing power. We can, therefore, congratulate the shareholders of this, the first Tramway scheme, not only of the Punjab, but of Upper India, that the carrying out of their project was entrusted to such hands as Messrs. Robson & Co., of Lahore, whose extensive establishments possess all the required agency and appliances for the undertaking. The laying down of the line, the construction of the necessary carriages, and the erection of a large range of buildings have all been carried out with expedition and satisfaction, as well as a supply of good horses arranged for or secured. The result is that the first section of the Tramway has been already thrown open for traffic, and things are so assuring in connection with the prospects of the scheme, that extensions are spoken of to Meean Meer, Shalimar, and Niaz Beg. The cars are said to be quite lightly constructed, and capable of carrying 24 passengers in each. They are drawn by *single* horses, and considering that all the Tramways of Calcutta, Bombay, and Kurrachee get their horses from Lahore, it may be assumed that the local scheme will have the pick of the stock, and add much to the popularity of its working. The success so far achieved has been productive of good, for we are informed that a Tramway is about to be constructed at Rawal Pindi. Nor is it likely that the example set by the enterprise of Lahore will end there. A number of other lines are in contemplation, requiring only the persevering energy displayed at Lahore to become accomplished facts—remunerative and popular.

Notes and Comments.

BOILER INSURANCE.—The Chief Engineer and Manager of the Boiler Insurance and Steam Power Company, Limited, Manchester, writing to us, under date the 6th December last, says:—" I am interested to learn that the question of Boiler Inspection is beginning to occupy attention in India. The Government here are moving in the matter of compulsory Inspection of all land boilers, and they intend to bring in a Bill with that object next Session, if practicable.

A BRIGHT PROSPECT.—The country between Kassauli and Simla is said to be rich in silver, lead, and copper, but there being no convenient supply of fuel they cannot be worked successfully. Coal, however, has been found near enough to become available when the railway is made, and its good quality and abundance indicate that the financial argument against the railway is not only a chimera, but an obstacle to the development of the resources of a now comparatively barren district.

BEHEEA SUGAR-CANE MILL.—As far back as 1879 we had occasion to make known to the Australian planting community this portable cane-mill, which, if we recollect aright, was then noticed by the *Pioneer* for the first time. We have since watched with interest the progress of the growth of the popularity of this excellent machine, which is now sold by thousands in the sugar-producing districts of India. From our own observation in Oudh of the system adopted by the Patentees for introducing their Mills among the native sugar-growers, we are not at all surprised at its success, which is as much due to well-directed energy and judicious action as the many mechanical advantages undeniably possessed by the appliance.

THE AGRA BORING.—The artesian well boring operations at Agra, having been continued by the Municipality for some time after geological experts had declared all chance of reaching a water-bearing stratum had ceased, was finally ordered to be abandoned, and the operation of drawing the pipes is now in hand. The failure, so far, of the experiment is to be regretted ; but there seems no reasons why a further trial should not be made in a more favorable locality and with improved apparatus. The Lucknow water-supply must ere long be seriously considered, and in view of the enormous advantages that would accrue to the whole of the province, should an artesian well boring turn out to be feasible, there seems every reason for not allowing the experiment to fall to the ground on account of the failure at Agra.

PROPOSED ARTESIAN BORING IN THE SUNDERBUNS.—We are informed that the Port Canning and Land Improvement Company purpose improving their property at the Mutlah *embouchure*, by sinking an artesian well with the view of obtaining *fresh* water. We believe that

it is the intention of the Company to bore to the depth of 250 feet in the first instance. This, we think, is all that will be necessary, for the results of the Fort William boring show that "there are no springs but of salt water likely to be met with in the vicinity of Calcutta within 70 or 80 feet of the surface:" and it was further shown that "there are fresh water springs at a depth not exceeding 130 feet, and that their source is of sufficient height to allow them to rise to within 4 or 5 feet of the surface of the most elevated lands on the banks of the Hooghly."

PAPER-MAKING IN INDIA.—We learn that the Titaghur Mill is about increasing its plant, which will tend to lessen the cost of paper in the Bengal market, and, doubtless, affect foreign importation to some extent. Calcutta supplies both Madras and Burmah in respect to some of their wants in the matter of stationery. We are informed that in Madras alone last year "local purchases" of stationery exceeded 2½ lakhs of rupees, and that this was mainly due to the substitution of printing paper manufactured by the Bally Mills Company for similar paper formerly got out from Europe. It was recently suggested that the card board for Railway tickets used in India might be manufactured by the Paper Mills of the country, but such a suggestion could only have been made by some one ignorant of the fact, that the card board in question demands special appliances restricted in England to only one or two establishments which supply the like requirements of the Continent of Europe and other countries.

WOODEN PAVEMENTS IN CALCUTTA.—Our attention has been invited to the Gate and Portico roadways of the E. I. R. Offices, Calcutta, where wood has been used for the first time in the Indian Metropolis as a surface material for pavements. In this case the pavement consists of rectangular blocks of wood seven inches deep, set on end, that is, with the fibres vertical, resting on a bed of portland cement concrete four inches in depth. The blocks are four inches wide, but of variable length, and laid diagonally from the centre line, herring bone bond, on either side. Felting is interposed between the blocks, and the interstices above filled in with gravel or khaimera. The top edges of the blocks are bevelled, and the pavement presents a neat appearance. These pavements have been extensively used in Russia and America, and were introduced into London in 1835. If we recollect aright a communication to the Scottish Society of Arts showed that blocks so placed with the end of the grain exposed wear less than granite.

ROORKEE FOUNDRY AND WORKSHOPS.—The necessity for any longer retaining the Roorkee Foundry as a Government institution has long been under consideration. The opening of the Oudh and Rohilkhund Railway extension through Roorkee, by connecting that station with the main Railway systems of India, was thought to be a favorable opportunity for disposing of the Roorkee shops to some private company, if such could be found willing to take over the concern at a fair valuation. Under instructions from this Government, and with the sanction of the Supreme Government, inquiries with this view were made at Bombay, and finally negociations were commenced with a Bombay firm, representing a London syndicate, for the purchase of the shops. These negociations have not up to the present led to any final purchase, owing to the syndicate being unable to comply with all the conditions regarding payment. Negociations are still, however, in hand, and there seems a probability of the sale being finally completed on satisfactory terms.

Current News.

MAJOR P. HOWARD and Captain S. Grant, Royal Engineers, have elected for continuous service in India.

THE Toungboo-Mandalay Railway, it is estimated, will cost Rs. 75,000 per mile, which will give a capital outlay of 180 lakhs.

THE Jeypur garnet works record last year, under the management of Mr. S. J. Tellery, a profit of something over Rs. 17,000.

SIR H. C. MANCE, KT., C.I.E., Engineer and Electrician, Persian Gulf Telegraphs, is permitted to retire from the service, with effect from 23rd December 1886.

IT is stated that the Government is about to advance a loan of eight lakhs to the Allahabad Municpality for the purpose of carrying out a scheme for a water supply for the city and cantonments.

GOODS trains have been running over parts of the Purneah Railway for some weeks past. It will probably be opened for passenger traffic in February next.

IT is understood that Captain Peacocke, R.E., is engaged in preparing a complete report with sketches of his experiences with the Afghan Boundary Commission.

THE first smelting process has been succesfully carried through at the Baragunda Copper Company's works, and in a month or two the shareholders should be in a position to know if they have made a spoon or spoilt a horn.

COLONEL WALLACE, Consulting Engineer, having inspected 120 miles of the Sindh-Sagar State Railway, from the crossing of the Chenab to Bhakkur, recommended its opening from the 1st instant.

A DEPARTMENTAL Committee is now sitting on the system of statistical and other work in the office of the Director-General of Railways, of which General Hancock is President and Colonel S. Trevor, Colonel Pemberton, Colonel Smith, and Major Gracey are the other members.

NOTWITHSTANDING unfavourable circumstances, the working of the Port Commissioners' tramway last year was very satisfactory, as the receipts amounted to Rs. 1,60,443 which was very nearly the highest sum ever received, though the receipts of 1882-83, were Rs. 100,549.

IT is understood in London that the directors of the Eastern Mysore Gold Company have been successful in raising the capital required to lease and work the mining property extending over 198 acres, lying immediately east of the Mysore Company's Mine.

THE works in connection with the construction of the Toungboo-Mandalay Railway have been formally placed under the control of the Director General of Railways. The project will be called the Toungboo-Mandalay extension of the Burmah State Railway.

WE may note that Colonel Merriman in charge of Bombay Defences, returned to Bombay by last mail, and that two of the new mining torpedo boats have already reached Aden on their way eastwards. One of them is said to be destined for Bombay, the other for Rangoon.

ON the 17th December last took place the opening of the Nepalgunge extension of the Bengal and North-Western Railway. The ceremony was performed by Colonel Forbes, Commissioner of Fyzabad. The line appeared in first-rate order, the special train running without a jolt. The extension opens up an important tract of country, and is a valuable adjunct to the system.

THE military authorities in India have under consideration the introduction of ballooning into India, and, in connection with this subject, Lieutenant J. R. L. Macdonald, R.E., has been placed on special duty at Roorkee for the purpose of preparing and submitting a scheme for its introduction into this country. While engaged on this duty, Lieutenant Macdonald will be attached to the Bengal Sappers and Miners.

THE Makum coal fields, as anticipated, have met a very large demand for their produce. In last year's report on the river-borne traffic of Assam it is stated that these mines now supply nearly all the coal required by the increasing steamer and railway traffic of the province, and most of the coke used in tea manufacture. If this statement is correct Makum coal has an assured prospect of a prosperous future.

THE question of the salaries of the subordinates on the State Railways is under consideration. The heads of the State Railways have been asked for their opinion as to the desirability of abolishing the present system of incremental salaries, and introducing a system by which the employés could be paid at their actual market value,—that is, having consideration to the nature of the duties performed by them, and the locality where they are employed.

AN unfortunate accident has occurred to the Jhelum Bridge on the Sind-Saugor State Railway, which is being constructed at Chak Nizam. One sleeper stack, which formed part of the staging of the second span, took fire. Every effort was made to get the fire under, but, owing to a sharp breeze, the whole of the staging was in a blaze and the girders fell with a crash into the river, and only by the greatest exertions was a temporary wooden bridge close by saved from destruction. No injury to life or limb attended the disaster.

THE Government having ruled that there was no objection to the Government brick kilns complying with indents for tiles,

&c., for State requirements, a great deal of technical work hitherto executed by the Madras School of Arts has been taken away therefrom. This has consequently limited the operations of this institution, so that a large number of men in the pottery department have had their services dispensed with, and the glass painting industry, which has brought so much credit to the school, is almost at a standstill, and threatens to become numbered with the things of the past.

FOLLOWING the example of his elder brother—Colonel William Spottiswoode Trevor, Bengal Royal Engineers, Chief Secretary to the Government of India, in the Public Works Department, who retires on pension in the coming financial year—Colonel S. T. Trevor, R. E., Secretary and Chief Engineer to the Government of Bengal, in the Public Works Provincial Department, and Director and Chief Engineer, State Railways, Bengal, will also proceed to Europe in March next on retirement on pension, and Colonel J. M. McNeile, R.E., will be appointed Chief Engineer and Secretary, Bengal Public Works Department.

A CONTEMPORARY'S Delhi correspondent writes :—Messrs. Meakin and Co., of Mussoorie, have decided to open a branch brewery here. A piece of land has been taken up for the necessary buildings, and the work will soon be put in hand. The two ice companies—the Punjab and Hindu—have been doing a good business, and the competition has had the effect of giving the local public ice at the pleasant rate of nine pies the seer. But, for real go-a-headedness, the Royal Flour Mills Company of Bombay beats anything I have seen in Delhi yet. Scarcely a year ago the Company acquired a piece of land to the south of the ridge with the object of opening a branch business here, and since then they have struggled through all the red-tape difficulties, their buildings are almost finished, and they hope to commence work early in the ensuing year.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

PROVINCIAL PUBLIC WORKS.

SIR,—A recommendation has been made to the Government of India by the Finance Committee that all Local Funds Public Works establishments should be abolished and the execution of District Works entrusted to the Public Works Department, Provincial branch. They, however, point out that in former years all Public Works were carried out in this manner, but that where separate establishments were entertained for Local Works and Provincial Works, respectively, it was found to result in a saving to Local Works of 1½ lakhs of rupees a year. Under these circumstances it does not seem very clear why they wish to go back to the old system, unless it be to relieve Provincial and Imperial charges by imposing more expensive establishments on Local Boards.

The Government of India very properly point out that such an arrangement would destroy the recently created responsibility and independence of Local Boards, and that it would be justly regarded as an impolitic and retrograde movement through the length and breadth of the land. At the same time they suggest that it may be possible for the Local Boards to maintain Provincial and Imperial Works in some cases on a paymemt of a percentage for establishment.

The importance of this suggestion will be clearly brought home by a few figures. Taking the North-Western Provinces and Oudh for an example, we find that the expenditure in 1885-86 on actual Works was about Rs. 46,00,000, divided as nearly as possible equally between Local and Provincial, while the establishment charges were—

Local	Rs. 4,15,000
Provincial	„ 6,91,000
Total Rs. ...	11,06,000

If the proposal of the Government of India were adopted the local establishment would require strengthening, and Superintending Engineers and their establishments would have to be kept on, the cost of which we might roughly estimate as under :—

The cost of 4 Superintending Engineers including establishment, at Rs. 2,500 a month ...	Rs. 1,20,000
Additional establishments for Local Boards at 200 a month, average, in 49 districts	Rs. 1,17,600
Total ...	Rs. 2,37,600
Or adding present cost of Local establishents ...	Rs. 4,15,000
The total charge would be	Rs. 6,52,600

Or, a percentage of 14·1 on work done (taking this at Rs 46,00,000) against a present percentage of 18 per cent. on local Works and 30·02 per cent. on Provincial works.

Or, in other words, the Local Funds would profit by getting more work out of their establishment in proportion to their remuneration, and the Provincial Works would profit by getting their work done by a more modestly paid set of men, and the saving in the North-Western Provinces and Oudh alone would amount to no less than Rs. 4,53,400.

H. W. H.

[Minor Irrigation Works are maintained and Civil Buildings repaired in some Districts of Madras by L. F. establishments on payment of the usual percentage.—*Ed. I. E.*]

Literary Notices.

SPECIFICATIONS OF WORKS, WITH A FEW USEFUL RULES, FORMULÆ AND TABLES, ILLUSTRATED WITH EXAMPLES. *By Rai Bahadur Kanhya Lal, M.I.C.E.* Lahore : The New Imperial Press 1886.

THE author of this pamphlet is well known as the most distinguished of the Native Members of the Profession in India. He has unquestionably achieved a wider repute than any of the many alumni of Roorkee, and is evidently not disposed to rest on his laurels or enjoy a well earned repose after thirty years' active service in the Public Works Department, from which he retired as an Executive Engineer of the First Grade a few years back. His fame and name are so familiar to the majority of our readers, that it is almost superfluous to discuss the merits of another work from the same source further than to assert that it fully maintains the standard of those that have come before it. The pamphlet is dedicated to Sir Charles Aitchison. It affords within a small compass much valuable information, which cannot fail to prove useful to officers and subordinates of the Public Works Department. It contains information similar to that given in Tyndall's expensive treatise on the same subject, but is much cheaper than that work. It should, therefore, find a ready sale.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS. THE GEOLOGICAL MAP OF THE UNITED STATES. *By C. H. Hitchcock, Hanover, N. H.* (St. Louis Meeting, October, 1886.)

THE publication by the American Mining Institute of a small geological map of the United States calls for an explanation of its peculiarities. The title intimates that it is intended "to illustrate the schemes of colouration and nomenclature recommended by the International Geological Congress." By way of further explanation it is said to be "based, by permission of the Director of the United Stakes Geological Survey, upon the map published in his Fifth Annual Report, the portions not coloured in that map being here supplied from other sources."

The colour scheme of the International Congress agrees in many respects with the usage of American geologists prior to 1875. The latter commonly used yellow for the Tertiary, green for the Cretaceous, dark gray or sepia for the Carboniferous, rose or carmine for the crystalline, vermilion for the volcanic, and the former propose to continue to use these. Usage has varied for the other systems.

In regard to nomenclature, the value and order of time-words and stratigraphic designations have never been based upon any natural relations. Consequently great relief is afforded by a majority vote of the geologists of all countries.

Because of the increasing diversity in the particular colours employed to represent rocks by geologists in different countries, and of the existence of very dissimilar schemes of nomenclature, we can only echo the recommendation of the author, that all geologists adopt the schemes of colouration and of nomenclature proposed by the International Geological Congress.

USEFUL RULES AND TABLES RELATING TO THE MEASUREMENT OF TIMBER, ILLUSTRATED WITH PRACTICAL EXAMPLES. Second Edition. Revised and Improved. *By Rai Bahadur Kanhya Lal, M.I.C.E.* Lahore : The New Imperial Press. 1886.

THE aim of this book, like others of its class, is to save the trouble of computing by the ordinary processes, and thus effect a corresponding saving in time which might be devoted to other useful purposes. These Tables, however, possess the advantage of giving at sight the cubic and superficial contents of round, as well as sawn, timbers, of different girths and scantlings. In using them, it is only necessary to measure the girth and length of the timber, or the length, breadth, and depth, as the case may be, to obtain the required results by a simple reference—without recourse to calculation. As far as we are aware, no other work affords the same facilities for like objects; and the value of the Tables are enhanced by an explanation of the principle of the rules for using them. The present edition is as correct and free from defects as is possible, which should be an additional recommendation for its wide adoption by those for whose especial use it is intended.

General Articles.

REPORT ON DESIGN PREPARED FOR THE COLLEGE FOR THE CHIEFS OF THE PUNJAB AT LAHORE.

(Continued from last issue.)

It will be observed that—

Every room has thorough ventilation. No rooms overlap each other.

Each Class room has a separate entrance, so that the pupils of each class, can come and go, without interfering with each other and can leave their shoes, if necessary, under cover in the verandah opposite their own class room.

Folding doors can be put if desired, between some of the class rooms, so that two class rooms can be thrown into one, if desired.

Each Class room can be easily connected with the Theatre or Speech room by opening the doors between, which have been designed large, for this purpose.

The Principal's room is placed so as to be near the Theatre, and all the Class rooms; yet sufficiently independent of them. It has a verandah on two sides and is not far from the Office, the Visitors' room, and the Entrance Hall; being only separated from them by the covered Portico.

The Office is placed at one corner of the entrance close to the Portico, admitting of easy access from all sides and yet distinct from the other rooms, but within easy reach of the Principal's room and Visitors' room.

The Entrance Hall forms a convenient covered court open right through to a verandah on one side, and to the covered Portico on the other. It admits of plenty of light and air; it forms a cool resting place, for those whose business brings them to the office or Visitors' room; and is a place, where students or their friends can meet or wait in all weathers, without inconvenience.

The covered Portico is spacious enough to admit of two carriages passing each other. It is convenient of approach, is central—admitting readily to the Visitors' room, the Principal's room, the Office, and the Theatre. It will afford complete protection at all times from sun or rain. It is lofty and well lighted. On one side ornamental recesses are provided in the wall, for putting up Public notices.

The Terebaras on each side of the Vestibule or entrance to the Theatre afford a convenient place for guards or peons to remain without being in any one's way, and yet to be close at hand if required.

The Theatre or Speech room is placed in the centre of the building. Ample light and ventilation is provided by clerestory windows along both sides, above the roofs of the class-rooms, well protected from sun and rain. The doorways communicating with the class-rooms on each side, are purposely made larger than usual, so as to admit of the class-rooms being connected with the Speech room, if necessary, and when open, to admit of plenty of room for entrance or exit from the Theatre. The fan light may be filled in with glass or left open. If more privacy is required curtains can be added up to any height, or ground glass can be inserted, or glass or wood may be omitted altogether, and the arched openings may be closed with quilted curtain or purdas as in native palaces. The walls dividing the Class rooms serve as abutments to the arches of the Theatre. The side walls of the Theatre are also the walls of the Class rooms, which besides saving walling, protects the Theatre walls from exposure to the sun. Facility of ingress or egress is provided for by the main entrance from the covered Portico, also by three doorways on each side, and a doorway at the stage end, which can all be opened at the same time, if necessary. If tatties are ever required, they can be placed on the Class room doors on one side and there is no obstruction to a clear draught right across and through the Theatre. Should a stage ever be required for any purpose it can be easily arranged for at one end of the Theatre, where there is a recess $18\frac{1}{2} \times 15$ with a separate entrance from the back.

A flight of steps on each side admits to a gallery over the stage which may be found useful for ladies. A similar gallery is also provided at the opposite end.

The door from the stage admits to the Laboratory and Play room, and the steps on each side of the stage admit to the Library above them.

Store rooms are provided, below the stairs leading up to the Library from the Main Hall, and also two small kothas each 10×4 below the steps at entrance to Library at the other end.

The Lavatories are situated well out of sight, but in a central position. The approaches to them to be provided with swing doors, high enough to serve as screens, but all above to be open. A separate entrance is provided for servants to attend to them. Tubs for waste water or drains from the Lavatories will have to be provided for. A small staircase also for servants will lead upstairs to the Lavatories on the upper floor, which can be added when necessary and will be conveniently near the Library. Ventilation is provided for by an air shaft which leads from the ceiling of each room to the roof.

The Play room is away at one end on the ground floor so that the lads can go in or out easily. It is open on three sides, and is well protected by a verandah from the sun and rain.

The Library is at one end on the first floor connected by a staircase with the Theatre; at the same time it has also a main entrance to itself, clear of other rooms; so that any one desiring to visit the Library, can do so without having to pass other rooms. It is open on three sides, which admits of good light and ventilation and it is provided with a 12 feet verandah all round.

In addition there is an open Terrace overlooking the approach $22 \times 10\frac{1}{2}$ which will be found useful.

A clock is provided for in the design, but is not included in this estimate.

The interlacing arches in the *facade* of "Justitia's" design (taken from the old mosque at Cordova) have been necessarily omitted on the grounds of expense, but a separate slip is attached* to the side elevation to show the effect, and if funds are found to be available, and it is desired it can then be adopted.

In the main walls of the building, recesses should be provided of ornamental design, which will be found useful for recording the names of illustrious persons or successful students, or for inserting wise sayings of great men who have passed away.

The Building complete as shewn in the design, is estimated to cost *Rs. 2,25,996*.

S. S. JACOB, Lt-Col.,
Executive Engineer, Jeypore State.

TESTING NITRO-GLYCERINE COMPOUNDS.

It is well known that the attention of the Military, Engineering, and Ordnance Departments of the principal European countries, as well as of the United States of America, has been directed for many years past to the subject of the use of *explosives*, and the interest in this inquiry and investigation has recently become greatly strengthened by the increasing demand for destructive agents. Numerous experiments on a most extensive and costly scale have taken place, and probably every known explosive has been employed in connection with the trials. For a considerable period Guncotton appeared to find most favour, but within the past few years that explosive has had to give place to rival compounds which, while possessing all the advantages claimed for Guncotton, have been found to be greatly superior in many important respects.

Of the numerous forms of nitro-glycerine compounds, perhaps "Dynamite" is the commonest, and even that has found a serious r[illegible] "Blasting-gelatine," which

* Shown in original but omitted in this copy.

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nade by Ram Sing the Head Assistant
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S. S. Jacob. Lt Colonel.

consists of nitro-glycerine and nitro-cotton, which together form a gelatinous mass possessing the unique property of being practically unaffected by the action of water.

Owing to the extending use of these explosives in the country, and the desire expressed for some particulars on the mode adopted at Home for testing their purity and stability, it is believed that the subjoined information may be opportune and useful.

Under the "Explosives Act of 1875" special licenses are required by persons intending to manufacture explosives, and these are granted, at first tentatively, by the Secretary of State for the Home Department, after full examination into the nature of the explosive, the place and mode of production, and, in general, the conditions under which it is proposed that the manufacture should be conducted. Being satisfied on these points, and after a series of chemical examinations of samples of the explosive, the license may be granted, permanetly, subject to a variety of conditions into which it is needless to enter. It was early recognised by the Home Office Department that in the case of all those explosives that had for their base nitro-glycerine special means ought to be adopted so as to ensure the production of compounds that would be perfectly safe under all ordinary conditions of manufacture, transport, and use.

If the nitro-glycerine is impure, the result will be a latent element of danger which is by no means obviated even by absorption of the liquid nitro-glycerine in an inert substance such as the siliceous earth known as Kieselguhr. Indeed there will then be inherent in the Dynamite thus produced a source of danger which is all the more serious because it may be unsuspected—nothing in the appearance indicating that the explosive differs from carefully prepared Dynamite, containing only "thoroughly purified" nitro-glycerine. Impure Nitro-Glycerine contains more or less free acid, and it only requires favouring conditions to cause decomposition to be set up to be rapidly followed by spontaneous combustion.

To guard against the possibility of accident occurring through the medium of imperfectly purified nitro-glycerine, a test was fixed several years ago by H. M. Inspectors of Explosives, and it was made obligatory that dynamite and other nitro-glycerine compounds manufactured, sold, or imported into Great Britain should pass this test. This test, it might be observed, appears very rigorous; but notwithstanding its apparent severity all that is required is care and attention during all the processes of manufacture, and while that may involve, as compared with less perfect methods, some additional expense and supervision of workers, the result attained is complete immunity from accidents in connection with the manufacture of dynamite, and the finished product is of a *perfectly uniform and stable character.*

It ought now to be explained that hitherto none of the Continental Governments have adopted any standard by which to judge of the purity of nitro-glycerine compounds, although it is understood that in France the question has received some consideration. The result, however, of neglecting to take this simple precaution is that explosions in Continental Dynamite Factories have been of frequent occurrence, and what is perhaps still more serious, imperfectly manufactured compounds have been freely exported from Continental ports to many parts of the world.

The Government of India, profiting by the experience thus gained, and influenced by the good effect of the working of the system in the old country, have recently adopted the British Government test for all dynamite and other nitro-glycerine compounds imported into India; but they have gone a step further than the Home Government and have insisted that vessels containing such explosives were not to be allowed to land the stuff until samples have been taken and examined by the Government Analytical Chemists at the various ports. In the case of Nobel's Explosive Company, however, special exemption has been made on account of the high character of the product, which is manufactured according to the tests imposed by and under the inspection of the British Government.

[Since writing the above, we find in the *Gazette of India*, January 1, 1887, a Draft Rule which the Governor-General in Council proposes to make on the subject of the Tests which certain explosives shall be required to pass before their importation is permitted, and which Tests are given *in extenso* in the said Official Notification.—*Ed. I. E.*]

COKE MAKING AND COLLECTION OF TAR IN BENGAL.

DURING the last ten or fifteen years coke manufacture has become quite an industry at most of the Bengal collieries, and is chiefly made from the "slack" or "small coal" raised from the pits. Formerly this was thrown away as refuse, there being no market for dust; besides there were then very few seams of coal worked that would make coke.

Now we have seams of coal worked at Sitarampore, Burrakur and Giridi, all of a highly bituminous character, which make excellent coke from the small slack. Such coke commands a good price and ready market, and gives Coal Companies a good profit. In taking up coal lands, or opening new collieries, coke making is of great consideration as non-coking coals are a drug in the market.

The coke is generally used by the Bengal Iron Works, "Loco. Works," and Indian Foundries; also large quantities are sold for tea drying, instead of charcoal, which latter has become very dear and scarce in some tea districts, especially Darjeeling.

There are several ways of manufacturing the coke. The systems now in general use in Bengal are common "clamp open ovens." The Beehive oven was tried at Sitarampore, but proved a failure, not being suitable to the native work-people. The open clamp ovens turn out some very fine coke, where proper attention is given to the working of them, which is a very simple process, and suits the native work-people very well; but it may be said to be one of the most wasteful systems that could be used, as it requires the best of coals and the best attention that can be given to it. The average outturn is not more than 30 per cent. of first-class coke all the year round; some part of the coke is burnt to ashes, some is over-burnt, and some of it under-burnt, which reduces the outturn of first-class coke considerably. Very often in the rains these clamp ovens are burning from 14 to 20 days, so that it is no secret why the coke is not better in quality and out-turn. The ovens vary at different collieries as to size but this is about the average of them: length 30 to 60 feet, width 5 to 7 feet, depth 5 or 6 feet, with 9 inch flues crossing them—about 2 feet apart—for the firing.

Now that the sale of coke has become regular, and can be relied on, better systems should be introduced. Some collieries would pay very well to be worked as coke concerns only, like some of the English collieries who crush up the steam coal. In many of the Bengal collieries washing would be unnecessary, as the coal is very free from shale bands, but the system of open ovens will never pay for coking steam coal, on account of the great waste, and they would not stand the heat required of them.

We understand a new kind of closed ovens has been introduced in Sitarampore, called the Welsh oven, but the experiment was a failure, because the ovens were not fitted up with proper arrangements to warrant them a success.

The common Welsh oven is a closed one; they are for the purpose of coking steam coal on a large scale, or large quantities of dust, which makes a much better coke, with very much less waste. The outturn is generally about 50 per cent., an increase of 20 per cent. over the common open ovens.

These ovens are generally made to hold about eight tons of coal, which is loaded from top of the oven by hopper waggons, which run over on tramways. The oven door is portable and can be readily raised up and down at will by a balance weight. The coke charge is drawn out by traction or fixed engines, by ropes or chains fastened to sets of fire

irons which lie on the oven floor, with scrapers at the back. When all the arrangements are well fit up and complete, an oven can be drawn and loaded again in 20 minutes.

The ovens are never allowed to get cool, and this is where much time and profit is saved.

The average time for one of these ovens to carbonize eight tons of coal is four to five days.

The drawbacks against the Welsh ovens described for this country are, that, they are very expensive to build, requiring expensive fire bricks and fillings, not easy to repair, and will not work to be payable less than 20 in number.

Further they must be kept going, not allowed to cool down or be stopped for fuel, in *poojahs* or holidays. They must also be worked on a large scale, and are therefore unsuitable for any small colliery.

(To be continued.)

THE HOOGHLY BRIDGE.

Our Promised Comments.

To the new Hooghly Bridge, we think, may be conceded the distinction of being one of the ugliest of modern bridges yet constructed. To an Engineer or a Mathematician who can at a glance comprehend all the strains of the several parts, it is constructively perfect, but to an ordinary mind the junctions of the several girders—to one who knows nothing of cantilevers—and one girder sitting intermediately on the piers, the whole is an enigma. The two apparently weak and ugly points at the junctions naturally suggests the question why were the piers not placed at these junctions? That the actual design is ugly there can be doubt, and it contrasts singularly with what was a pretty design in Mr. Leslie's first and we believe his own inspiration. The two sketches accompanying will show the difference, and we believe that our readers will admit that the original design conveys to the ordinary mind an impression of greater security. Whether economy was the motive, or simplicity, or strength, that induced the alteration in the design we cannot say, except that it was not facility of construction; but we think there can be no two opinions as to which would have been the better artistic treatment of this great work.

RANGOON DRAINAGE PROJECT.

Shone's Hydro-Pneumatic System.

We have prepared (1) a project for the Sewerage and (2) a project for a supplementary high-pressure Water Supply for your city, on the Shone Hydro-pneumatic System.

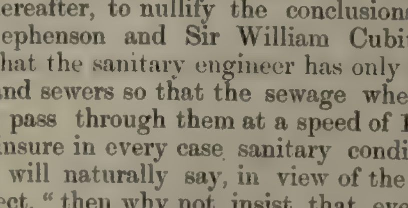
Before we proceed to describe these in detail we propose to explain briefly the conditions which must be observed if you would institute works of Sewerage at Rangoon which should after execution prove to be sanitary and not insanitary. It is not difficult to distinguish between sanitary and insanitary works of sewerage. The former do not permit of liquid sewage lying in house-drains and sewers long enough to decompose and give off noxious and dangerous sewage gas, whilst the latter, for want generally of natural conditions favourable to gravitation drainage, such as good inclinations for the sewers, permit the sewage to pond in the house-drains and to meander as it were in the sewers on its way to the outfall, thereby creating the very conditions which it is the province of the sanitary engineer to remove—*viz.*, conditions favourable to deposit.

Sir Joseph Bazalgette, C.B., C.E., in his report on the main drainage of London, with a view to draw attention to the necessity there is for the observance of hydraulic laws in the construction of sewerage works, quoted from the report of the late Mr. R. Stephenson and Sir William Cubitt of the 11th December, 1854, in which it is said :—

"No part of engineering science has been more industriously investigated than the laws that govern the flow of water in pipes and open channels; and it is probably not too much to say that the formulæ which represent these laws rank amongst the most truthful that the professional man possesses. They have been the subject of laborious experimental investigation of the most elaborate character, and their results have been tested by the practical man, under every variety of conditions, without their truth being impugned in the slightest degree. The principles upon which they are founded have been sanctioned and adopted by Prony, Egtelwein, Du Buat, and others, and it is to them that we are indebted in a great measure for the simple, practical form which they present. Our own engineers have modified them to suit particular circumstances, and given them more extensive usefulness. Mr. Hawkesley, amongst others, has especially contributed to render the principles which they embrace applicable to almost every variety of condition which the complete drainage of large towns involves; and we shall have occasion almost immediately to adduce some instances within the Metropolis where the facts confirm theoretical deductions in a very remarkable manner, and lead irresistibly to the conclusion that they may be implicitly depended on."

The facts discovered by Sir Joseph Bazalgette, which went to corroborate the science of hydraulics as it was then, and as it is still understood, may be summed up to mean that the sizes and inclinations of all drains and sewers should be so designed that when the greatest quantity of sewage is passing through them the velocity of the sewage should be 2½ feet per second or 150 feet per minute at the least, otherwise the conditions favourable to deposit would obtain. You may take it from us that nothing has transpired since 1854, nor can anything transpire hereafter, to nullify the conclusions arrived at by Mr. Stephenson and Sir William Cubitt. Seeing, therefore, that the sanitary engineer has only to lay down his drains and sewers so that the sewage when it enters them shall pass through them at a speed of 150 feet per minute to insure in every case sanitary conditions. The uninitiated will naturally say, in view of the importance of the subject, "then why not insist that every sanitary engineer undertaking drainage works shall so design his drains and sewers that they cannot fail when executed to convey the sewage to its destination at the prescribed velocity." But, unfortunately, although it is well known that water-carried sewage so conveyed will be fresh and will render the house-drains and sewers clean and free from deposit, it is nevertheless the fact that engineers are unable, by trusting to gravitation drainage, to bring about the conditions essential to sanitary sewerage.

The following diagram will help you to understand the natural difficulties in the way of the sanitary engineer getting a velocity of 150 feet per minute for the sewage in his sewers, when he has no trust to the law of gravitation alone, in towns situated on a practically level surface having no natural outlet for their sewage except the river or sea :—



Cases resembling the above are numerous, and wherever they exist the results are invariably protested against and condemned as inimical to the worst degree to scientific sanitary drainage. If the sewage *must* be made to flow from the town to the sea at the prescribed velocity of 2½ feet per second, the outfall sewer *must* be laid at the inclination shown by the dotted line from *a* to *b*. The slightest deviation from this inclination will alter the velocity. If the inclination is reduced the velocity will be reduced also, and *vice versâ*. But engineers, rather than propose that a deep sewer of this kind should

Original Design.

Actual Design.

be constructed, and a pumping shaft be sunk upon it to raise the sewage into the sea from *b* to *d*, as it gravitated to the point *b*, prefer to advise the construction of an outfall sewer from the point *a* to the point *c*, for the simple reason that it is the only plan permissible from a *ratepayer's* point of view. The arrangement, however, is fatal to the sanitary aspect of such a sewer, for it can never pass the sewage to the outfall at a velocity of 2½ feet per second even if its outlet end were free; but being during certain hours of the day tide-locked, the sewage during those hours ponds between *a* and *c*, and consequently the very best conditions favourable to their becoming foul sewers of deposit are thus brought about. Were it not for the interposition of the hydraulic law, the engineer would lay his sewer from the point *a* to *d*, keeping its invert always above high-water mark, so that the sewage would have a free outlet at all times of the tide into the sea. But knowing that by constructing a sewer from *a* to *d* it would be practically level, and would permit of no velocity at all scarcely being given to the sewage, he compromises as best he can with the laws of nature and the pockets of the ratepayers by designing his sewer to suit the inclination represented by the dotted line *a c*; and were sewage *eau de Cologne* this arrangement could not be improved upon probably; but inasmuch as stagnant sewage decomposes, and is offensive and prejudicial to health, no reasonable expenditure should deter a sanitary authority from putting their veto upon any plan which will fail when carried out to remove the sewage to the sea sanitarily complete, tide in or tide out.

(To be continued.)

ELECTRIC LIGHTING IN CALCUTTA.

THE illumination at the Great Eastern Hotel, Calcutta, on Christmas Eve merits a passing notice as much for the novelty (for Calcutta) of the light used as for the brilliant effect produced. Arc lighting is too effulgent and glarish for internal lighting, and has been for such purpose discarded in Europe, but in Calcutta, hitherto, it has been the only kind of electric light available and the term "Electric-light" has perhaps been thereby synonymous with a blinding flood of light. The Incandesence Lamp, as used on the occasion noticed, however effects a sub-division of the light in a very satisfactory manner for internal lighting, and while giving the light a beautiful tone it causes no pollution of the atmosphere—a fact very noticeable on the occasion referred to by the multitude of visitors who thronged the "Hall of All Nations." The light was yet softened and diffused by very pretty opaline shades of various tints, rendering the scene, as has been described, a veritable fairy land.

The installation consisted of 150 Incandescence Lamps, each of 20 candle-power, maintained by a alternating current "Ferranti" dynamo machine separately excited by a small dynamo of the Gramme type. The E. M. F. of this machine at 1,000 revolutions was 77 volts, and the current given off was 112 amperes, the whole being driven by an eight horse-power portable engine.

This is, we believe, the first installation of the Incandescence light made in Calcutta, and the enterprise of the contractors, Messrs. Walsh, Lovett & Co., in placing this beautiful light within easy reach, is certainly to be commended.

THE MOUNT MORGAN GOLD MINE.

NEAR ROCKHAMPTON, QUEENSLAND.

(From Our Special Correspondent.)

ALTHOUGH the history of gold-mining in Australia teems with extraordinary discoveries of mines and gold fields, it may be fairly asserted that the now celebrated Mount Morgan mine eclipses them all as regards its estimated value, while it becomes particularly interesting to the engineer and chemist in consequence of its having been instrumental in developing a process of great perfection, for the extraction of the precious metal from refractory ores.

The mountain is situated about 22 miles from Rockhampton in a south-westerly direction, and its summit is about 1,200 feet above the level of the sea. The principal mine is at the top of the mountains and is approached by a very steep road and finally near the ridge by zig-zags which are only available for foot traffic. The stone which is here quarried in the ordinary manner is tipped into a shoot close to the mine. In this way its descends for a considerable distance, and being caught in traps at the bottom of the shoot, and from them emptied into carts to be conveyed to the works, a distance of about half a mile.

Besides the mine at the summit, two tunnels have been driven into the mountain and another face opened at a lower level. Although as yet the stone has not been found to be of such a good quality as that quarried higher up, still very fair prospects have been obtained, which seem to show that the precious metal is diffused throughout the top of the mountain, and the supply of gold-bearing stone is therefore practically inexhaustible. The stone is thus described by the Government Geologist:—"The central portion of the upper cutting is a large mass of brown hœmatite ironstone, generally in great blocks, with a stalactite structure, as if iron oxides had gradually filled up cavities left in the original deposit. The ironstone contained gold of extraordinary fineness, which however afer a little practice can be detected in almost every fresh fracture. The ironstone more or less filled with fine siliceous granules. Gradually to right and left of the central mass the silica more and more replaces the ironstone. It is a frosty, spongy or cellular sinter, sometimes so light from the enlargement of air in its pores that it will float in water like pumice. Fine gold is disseminated throughout this siliceous deposit as well as the ironstone." Stone from this part of the mine assays at from 6 to 10 ounces to the ton.

The stone of the lower mine consists of red and brown hœmatite mixed with aluminous rock and siliceous sinter, and assays from 3 to 6 ounces to the ton. Speaking of this part of the mine the Government Geologist says:—"I ground and washed a great number of specimens from both cuttings. and from every variety of material of my own selection, and was surprised and delighted with the prospects I obtained, in most cases from stuff which miners would regard as most unpromising."

In opening out the different parts of the mine, cavities have been met with, which have been frequently found to contain iron in the form of stalactites and stalagmites. These are often covered with ore of the most beautiful and brilliant peacock colours, and assume all kinds of fantastic shapes. Numbers of these samples are preserved in the office at the works and when broken across present a crystalline structure similar to coarse pig iron. In other cases the stalactites and stalagmites meet in the centre of the cavity and have the *appearance* of cast iron which has been moulded into these forms in the cavities, the sand having been subsequently swept clean away. Sometimes the roof is comparatively smooth, but the floor of the cavity is covered with stalagmites which look as if they had been forced in from above.

The expense of securing the stone is comparatively light, as it is at present merely cut away from the top of the mountain, so that an ordinary quarry has been formed from which tons of quartz can be displaced with a single shot. The gold is singularly pure. It is well known that gold is generally found in nature more or less alloyed with silver, yet this gold from Mount Morgan has been found to be free from silver—a minute trace excepted; and it is supposed to be the richest native gold hitherto found. Regarding the peculiar formation of Mount Morgan, it is asserted that the ridge is the result of a thermal spring which in past ages held quartz, iron, and gold in solution, and from which the gold has been precipitated in a finely divided state more or less covered with hydrated oxide of iron. The frosty siliceous sinter agrees in every respect with the deposits of the New Zealand and Iceland geysers. The frosty and cavernons conditions of the siliceous matter of Mount Morgan may be accounted for by the escape of steam while the silica was yet in the gelatinous condition so frequently observed in the deposits of hot springs. The aluminous silicates represent the familiar outburst and flow of mud. The gold, and to some extent iron, may have been dissolved out of the iron pyrites of mundic reefs; the gold possibly by chlorine produced by the contact of hydrochloric acid, derived from the decomposition of chlorides with manganese which occurs in combination with the ironstone.

In such active geysers as are accessible to observation, we find a narrow pipe or fissure terminating upwards in a crater-like cup or basin. It may be taken for granted that the Mount Morgan geyser was no exception to the rule, and it is thought the upper portion of the mount, where ironstone predominates, represents a basin in which silica, iron, alumina, manganese and gold were held in solution to be deposited when the bulk of the water from time to time withdrew into the pipe.

The extraction of the gold was (in the early days of the mine) effected by the ordinary quartz crushing and amalgamating machinery, but when it was discovered that only about half the gold was obtained in this way, some better process had to be adopted for the treatment of the tailings from the batteries. The chlorination process is now employed for dealing with the tailings; and if the theory of the deposition of the gold on the mountain be true, it will be seen that the metal is now being extracted by a process almost similar to that adopted by nature when the gold was first laid down on the mountain. The process of extracting the gold by chlorination is not new, but the method employed at Mount Morgan exhibits the latest improvements, and is on that account interesting.

The water which flows off the tables in the amalgamation process is carried by spouts to tanks, where it is allowed to stand, to give time for the suspended matter to settle, and when the clear water has been drawn off the tailings are carefully preserved for future treatment by the chlorination process. When about to be treated the tailings are roasted on an open hearth to decompose the water of crystallization. After roasting they are drawn from the furnaces and allowed to cool in sheds. They are next put into wooden barrels, or iron drums lined with lead, with certain proportions of chloride of lime, sulphuric acid and water. The drum is then securely closed and air is forced in, until a pressure of about 40lbs. per square inch is obtained, after which it is set revolving. A disengagement of chlorine then takes place under considerable pressure, which causes the gas to be easily dissolved, and produces a more concentrated solution of chlorine water than could be obtained on the ordinary atmospheric pressure.

The drums are kept revolving for one hour and a half during which time nearly all the gold is dissolved by the chlorine water. At the ordinary atmospheric pressure this process would occupy four times as long as in the present instance.

At the end of an hour and a half the air presure within the drums is withdrawn, and with it any superfluous chlorine; which is afterwards used in manufacturing chloride of lime for use in the chlorination process. The drums are then opened and the contents discharged on to separators below. These separators are constructed on the same principle as the laboratory filter pump, the passage of the liquid through the filter being accelerated by exhausting the air from a vessel underneath the filter and in close connection with it. The whole of the liquid bearing the gold in solution filters through the compound in the separator, and is conducted by pipes to vats where it is allowed to settle. The ore remaining on the separator is repeatedly washed with water to get rid of all trace of gold chloride; and the washings are added to the clear solution which is contained in the vats until on being tested they are found to be quite free from gold. The solution then flows from these vats through leaden pipes to large filters of vegetable charcoal. A clear liquid is here seen running from the pipes on to the filters which if tested with sulphate of iron will give a copious precipitate of pure gold; on the other hand, the liquid issuing from the pipe below the filter will give no such reaction, unless the charcoal is exhausted and no longer able to effect the precipitation of the gold from the solution. The chloride of gold on coming into contact with the charcoal is decomposed, the charcoal absorbing the chlorine, and metallic gold being precipitated in the pores of the filter. The precipitated gold has a reddish appearance due to a slight film of oxide of iron. After this charcoal has been removed from the filters and dried, it is roasted in a furnace, until the whole or nearly all the charcoal has been consumed, a small residue alone remaining mechanically mixed with the gold. The process is now nearly complete. The residue in the furnace being collected, it is smelted with borax and the resulting metal, after being refined in another smelting, is cast into ingots weighing 350 ounces and valued at about £1,250 each.

A daily sample is taken of the ore remaining on the separators, and the liquid running from the filters is not only tested frequently, but is pumped back to be used again in the drums, so that there is no probability of any gold being lost. The tailings from the batteries which are thus treated yield from three to four ounces to the ton, and the cost of the process is almost 30 shillings per ton.

Regarding the value of the mine, it has been estimated to contain gold enough to yield a profit, after working, of *nine millions sterling!*

Miscellanea.

ARCHITECTURAL TOPICS.

The *Builder* gives a plan of the projected Paris exhibition.

Mr. Christian has finished his examination of the designs for the Liverpool Cathedral.

It is not yet certain whether the guarantors to the South Kensington Exhibition may not have to make up for a deficit.

The mosaics covering the entire north wall of Chester Cathedral, have been finished by Messrs. Burke and Co., of 17, Newman Street, London.

Mr. John P. Seddon, Queen Anne's Gate, Westminster, has been appointed architect to the Dean and Chapter of Llandaff Cathedral.

Agreeably with the wish of the Queen, the foundations of the new Admiralty and War offices will be laid by her during her Jubilee year.

The *Architect* slyly yet wisely remarks, that it is wonderful how interesting and important a building is discovered to be when it is on the eve of destruction!

The London and North-Western Railway Company have arranged to carry slates direct from the North Wales quarries to the Continent at one through rate.

The *Building News* observes that a marvellous degree of uncertainty and vagueness exists amongst architects as to the essential characteristics of a well planned house.

It is proposed to erect a colossal monument of the Revolution of 1789, either in the centre of the Tuileries Gardens, or on the place where the Palace of the Tuileries once stood.

A congress, combined with an exhibition of works and communications on the results of past experience and studies made, will be held at Venice, in 1887, by the Italian architects and engineers.

The Institute of Architects have forwarded a memorial to the Metropolitan Board calling attention to the state of Staple Inn, and urging upon the Board the desirability of preserving the Hall.

It is pointed out in *The Builder* that Stonehenge is undergoing daily injury at the hands of an unchecked public, and it urges the security of this national relic from material decadence, which appears only too plainly to be overhanging it.

A new cement has been introduced by Messrs. Joseph Robinson and Co. (Knothill Cement and Plaster Works, near Carlisle), which bears their name. It is fire-proof, dries quickly, and presents a smooth and glossy surface of exceeding hardness.

Philadelphia will soon have the highest tower in creation. The Town Hall there (costing 20,000,000 dollars), which is rapidly approaching completion, will have a tower 537 feet high, *i.e.*, 27 feet higher than that of the Cologne Cathedral. Until the completion of the Eiffel Tower at Paris, Philadelphia will possess the highest building.

Iron is informed that it is intended to build a large tower—440 feet high at the extreme top, and 420feet at the top platform—in London. It is proposed to erect this structure at the top of Oxford Street, where the ground is high, and work is to be commenced next month. The ironwork is placed in the hands of the Horsley Iron Co., of Westminster and Tipton, whose tender is £10,000; the excavations and brickwork will be carried out by Messrs. Wm. King and Sons, of Pimlico. It is to be built in commemoration of Her Majesty's jubilee year, and while it will overlook every other structure in London from its top platform eight or nine counties will also be visible. Are we approaching another Babel-tower age?

TECHNICAL AND SCIENTIFIC ITEMS.

The Societe d' Encouragement offer a prize to £80 for a "heavy oil" engine.

M. Marcy, the well-known experimentor in instantaneous photography, has succeeded in producing photographs with an exposure of two thousandths of a second, and, with the assistance of M. Chevreul, he proposes to reduce this period still further. Truly marvellous!

The electric incandescent light, which has been applied to the taking of photographs in such inaccessible places as underground cavities, mines, and so on, is now to be tried by M. M. Bonfaute and Massoneour for photographing the sea bottom, sunken vessels and submarine works.

Messrs. Tuck and Co., of London and Liverpool, whose steam packing answers for compound engines working up to 90 lbs. pressure, have, in order to meet the requirements of triple expansion engines working at 150 lbs. and upwards, purchased the patent with the machinery and plant for the manufacture of Morrison's metallic and asbestos packing.

It may be pointed out that the Queen's Jubilee Year coincides with the 50th anniversary of the first practical working of the electric telegraph in this country, as it was on the 25th July, 1837,

that the first practical working of the Cook's and Wheatstone five needle telegraph took place between Camden Town and Euston Station on the London and North-Western Railway.

A very grave error attaches to all indicators made in this country owing to the manner in which the springs are attached to the end blocks; thus, as at present made, any compression put on the spring must put a twist on the end blocks, and the spring itself will assume a slightly bowed form, which twist will cause a frictional resistance in the cylinder proportional to its amount.

The breaking of ships' cables at launches when these are over-strained in checking the vessel's run into the water occasionally occurs, when the defective link is repaired and the ship sent out to sea. The over-straining of the cable leaves it ever after in a defective condition or dangerously unsafe in future emergencies, so that this practice should be abandoned, and shipowners should stipulate with the builders that their chain cables shall not be used for any other than their legitimate purpose.

A new bullet-proof material has been made by Herr Chas. Scarnejo of Vienna. It consists of a hard pad, two inches thick, and filled with cotton wool, chemically prepared. Bullets fired from an Austrian military carbine at 20, 30, and 100 paces not only stuck fast in the pad but were flattened. Altogether it was proved that at ranges beyond 200 yards the pad could not well be pierced through, by a first shot. The inventor claims that the pads, being compressed to a thickness of less than one inch, could serve as plastrons for soldiers. It is also suggested that screens made of this material and moved about on bicycle wheels might be used to cover gunners.

A new process of extracting sugar has recently been tested by Professor Wiley, of the United States Agricultural Bureau at Fort Scott, Kansas. It consists in chopping up the cane into small pieces ½in. thick, then steeping these pieces in tubs filled with hot water for two or three hours. The warm juice thus obtained is then heated and stirred and with the addition of lime brought to a boiling point. It is then allowed to stand for a time, the clear part being finally run into the vacuum pans and boiled into sugar in the usual manner. The yield is stated to be 164lbs. per ton, whereas by the crushing process adopted in Louisiana the corresponding yield is only 80lbs. per ton.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, January 1, 1887.

THE services of the undermentioned officers are placed at the disposal of the Government of Bombay for employment on Railways:—

Mr. H. H. Gahan, Executive Engineer, 3rd grade, on return from furlough.

Mr. E. H. Stone, Executive Engineer, 2nd grade, from Establishment under Director-General of Railways.

The services of the undermentioned officers are placed at the disposal of the Government of Bombay for employment on the Godra-Rutlam Railway Survey:—

From Madras Railway Surveys.—Mr. W. G. Gilchrist, Executive Engineer, 2nd grade.

From North-Western Provinces and Oudh.—Mr. R. R. Dease, Executive Engineer, 4th grade, Mr. E. W. S. Douglas, Executive Engineer, 3rd grade.

From Establishment under Director-General of Railways.—Mr. E. G. J. McCudden, Executive Engineer, 2nd grade, sub *pro tem*, Babu Kali Podo Sen, Executive Engineer, 4th grade, sub *pro tem.*

From Central Provinces—Mr. W. Slane, Assistant Engineer, 2nd grade.

The services of Mr. W. H. Parker, Superintending Engineer, 1st class, are, on return from furlough, placed at the disposal of the Government of Bombay for employment on the Godra-Rutlam Railway Survey.

Beluchistan.

Mr. W. B. Starky, Assistant Engineer, 2nd Division Frontier Road, is granted three months' privilege leave.

Mr. O. Ollenbach, Assistant Engineer, 2nd Division Frontier Road, is granted two months' privilege leave.

Military Works Department.

Lieutenant R. F. Allen, R.E., Assistant Engineer, 1st grade, is appointed to the charge of the current duties of the Office of the Executive Engineer, Fort William Division, Military Works, in addition to his own duties.

Assam, December 25, 1886.

18th December 1886.—No. 120.—In continuation of Public Works Department Notification No. 102, dated 22nd November 1886, Mr. J. Leonard, Assistant Engineer, 1st grade, whose services were transferred from Assam to Burmah, reported his departure from this Province on the 1st December 1886.

Bombay, December 30, 1886.

Major E. D'O. Twemlow, R.E., on his return from leave, to act as Executive Engineer, Poona and Kirkee.

Major W. H. Haydon, R.E., to act as Executive Engineer, Lower and Central Sind.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department:—

18th December 1886.

67.—George Turton, of Sheffield, England, Engineer.—*For improvements in buffers for railway and other purposes.*

210.—Charles Sheppard, of Bridgend, in the county of Glamorgan, England, Engineer.—*For an improved soorkee mill.*

211.—John Grant Smith, of Victoria, in the colony of Hong-Kong, Merchant.—*For the manufacture from fresh ginger, of dried ground ginger, crushed ginger, ginger paste, flour of ginger, essential oil of ginger and essence of ginger.*

217.—Thomas John Jones, of 11, Queen Victoria Street, in the City of London, England, Electrician.—*For improvements in voltai batteries.*

SELECTED ABSTRACTS OF RECENT INDIAN SPECIFICATIONS.

Ships' Draft Indicator.—185 (1886).—*John G. Dobbie.* A cylindrical vessel called the air chamber is placed near the bottom of the ship, amidships, into which water through the bottom of the ship is admitted, which rising in the air vessel compresses air in the vessel with a force equal to the immersion or depth of the ship in feet and inches below the surface of water. From the top of the air vessel a pipe is led to a pressure gauge or other suitable instrument for measuring pressure, such as a mercury gauge situated in the chart room or other convenient place in the ship, and the dial or index of the instrument being marked off in feet and inches with the corresponding displacement in tons for such depth of immersion, the pointer will always indicate the exact immersion and displacement of the ship when afloat. A tube is also attached to the air chamber in the water space, an carried up the central bulkhead to a sufficient height above the deed load line. This tube is of glass having a graduated scale attache to indicating the immersion and displacement also; and the head of water in the tube acting on the air in the air chamber equalizes the pressure when the ship is rolling and pitching, enabling the mean draft to be read off during any weather.

SELECTED ABSTRACTS OF RECENT BRITISH SPECIFICATIONS.

Improvements in Breech-loading and Magazine Fire-Arms.—9411 (1886).—*H. H. Lake.* This invention is a communication from the Winchester Repeating Arms Company of New Haven, Connecticut, United States, and relates to improvements in repeating fire-arms.

In the ordinary well-known "Winchester" repeating rifle, the cartridges, which are contained in a magazine tube beneath the barrel, are fed upwards to the barrel by means of a carrier sliding vertically in a slot in the lock, and the cartridge is pushed into the barrel and the breech closed by a breech-piece sliding in an axial line with the barrel.

These movements are effected by working a lever pivotted under the lock which also forms the bigger guard. Certain inconveniences connected with this arrangement have led to the adoption of a handle sliding on the magazine tube, to be grasped by the forward hand, for giving the required movements; and it is to fire-arms of this latter class that the present invention applies.

It is difficult to convey a complete idea of the mechanism without reference to drawings, but the main features of the arrangement are as follows:—

A handle, fitted to move to and fro on the magazine tube, has a slide fixed to it, passing between this tube and the barrel. A shot in the slide receives a pin on a cylindrical breech-piece, which is thus caused to reciprocate, and the shot being inclined, the breech-piece is partially rotated after the cartridge is pushed home, and locked by a shoulder formed it, engaging with a fixed projection in the lock. The carrier consists of two plates of peculiar form pivotted at one end in the lock.

The cartridge is received between them from the magazine and the first motion of the slide causes them to approach and grip it firmly, while the further motion of the slide, by contact with an upwardly projecting tail-piece on one plate, raises the carrier with the cartridge to the level of the barrel. A lever pivotted on the carrier and having a forked end embracing a stud in the lock supports the detonating end of the cartridge and is so arranged, that it causes the cartridge to be presented in a true axial line to the barrel, which is an important matter in repeating shot-guns, where the cartridges are necessarily flat ended. A species of spring latch on the lower part of the carrier presents the exis of the cartridges from the magazine when the carrier is raised, but permits the magazine to be filled through the opening in the bottom of the lock, when the carrier is so raised.

The return motion of the handle and slide bring forward the breech-block, which pushes the cartridge into the barrel, and is then locked as before described. The end of the breech-block acts on an incline on the carrier and returns it to the lower position, where it immediately receives a fresh cartridge from the magazine. When in such position the carrier fills the opening in the lock through which the magazine is fed.

The arrangements of the trigger hammer and exploding needle are of the usual description, with the exception that the hammer must enter a shallow slot or recess in the end of the breech-piece, before it can strike the needle, and until the breech-piece has been rotated and locked, this shot is not in a position to receive the hammer.

There are 11 plans of considerable length, attached to the specification.

Extracts.

HINDU *versus* ENGLISH WORKMEN.

MR THOMAS SCOTT, of Blyth, who recently superintended the building of two barges at Bhownuggur in the Bombay Presidency, has furnished his experiences to the *Newcastle Chronicle*. Mr. Scott was the only European workman employed, and had no knowledge of the language, but with the help of an interpreter, the natives very quickly learned the different parts of the barge. The average number of persons employed was about 250. Sometimes nearly half of those were women, who did exactly the same work as men engaged in labouring. Children of a very tender age were likewise counted among the staff of workpeople. Mechanics received eight annas—an anna would be worth about a 1½ *d.* in English money—per day; male labourers, four annas, and female labourers, three annas. Their day's work commenced at seven o'clock in the morning, and terminated at sunset, two hours being allowed for dinner at mid day, except in the hottest part of the summer, when there was a cessation of labour from eleven in the morning till two in the afternoon. With the exception of the rivetters, who were brought from Bombay, the whole of the work was done by the natives. Awkward enough some of the "hands" were when they commenced their tasks—and it was the less to be wondered at when many of them had not seen a steamship before—they adapted themselves to the work in an almost incredibly short time, displaying much intelligence, and specially evincing a strong desire to please. The quality of their work, according to the testimony of the State Engineer, Mr. R. P. Sims, was "quite equal to the same class at home;" but as was to be expected, the people are not capable of turning out the "quantity," and Mr. Scott is of opinion that one English mechanic would be worth from three to four native artisans. The time occupied in fitting up the barges was twelve months. As a class the natives are most temperate in their habits, and during the eighteen months which Mr. Scott was domiciled in the State, he avers he did not see a single individual intoxicated. Vegetarianism is predominant.

THE TOUNGHOO-MANDALAY RAILWAY.

THE flying visit made to Mandalay by Sir Theodore Hope, Public Works Minister, General Hancock, and Mr. Molesworth has resulted in the alignment of the new Railway from this city to the Myit Nge river, the site of the bridge over that stream, and the position and defensive works of the Railway terminus here being finally decided upon. All this has been done in consultation with the Commander-in-Chief, Sir Charles Bernard, and expert engineer officers. The total length of the line is calculated at 220 miles, and will, it is estimated, cost Rs. 75,000 per mile, which will give a capital outlay of 180 lakhs. Work has been begun from Tounghoo and Nyingyan, and a start will also be made on the Mandalay section. It must be borne in mind that in Burmah, where the rainfall is very heavy and the soil of a loose kind, the earthwork of a Railway must be left to settle for at least one rainy season before any great quantity of ballast can be safely laid down. The embankments sink about one sixth before finally becoming solid and firm, and this has always to be taken into account when a line is being made. As regards the new Railway, it is said that the line can be opened from Tounghoo to Yemethen (say 115 miles) and from Mandalay to Kyoukse 30 miles within 18 months of the first sod being turned; and the remaining section between Kyoukse and Yemethen (say 75 miles) be completed within another year. This is, of course, if funds are allotted liberally and orders are sent to England *at once* for rails, rolling stock, and the ironwork for the bridges—the last a most important matter, as the rivers are nearly impassable in the rains. Judging from the Rangoon-Prome Railway, a good dividend should be paid by the new Railway, as the former pays 5½ per cent. net. Some figures may be quoted showing the actual saving in the military budget and the greater expenditure secured in relieving posts. In 1881 the ordinary relief of the Tounghoo garrison by the Sittang river route cost Rs. 49,000 and occupied 25 days; in 1885 a similar relief by Railway cost only Rs. 9,000 and occupied two days.

DOING *versus* TALKING.

A NUMBER of native gentlemen at Bombay have, we hear, established a Flour Manufacturing Company. The intelligence has naturally delighted their Calcutta brethren, and we are not surprised to find the following pithy remark in one of the leading native papers:—"Though India is a great wheat-producing country, it is a shame that it has to import flour from such distant countries as England, Austria, and Italy. We think that if the manufacture of flour by the aid of machinery be undertaken on a large scale, India will be quite able not only to supply her own demands, but even to export to foreign countries" This is all very wise, we grant; but has the truth only just dawned on our contemporary? That India would be materially benefited if her people would only show a spirit of enterprise, is surely not a very great discovery. Not that any blame attaches to Bombay, for she has given ample proof of commercial life. But what have our valuable friends in Bengal done except make late discoveries and gape in motionless astonishment at patent facts? "Why don't we do this or that? asks some one very pleased with himself. "Ah, why" echoes another. And so the hum goes on: a stream of invectives is poured on selfish Europe; a great fuss is made over India's pristine glory—and then the noise subsides; the bubble bursts, as every bubble must. Nothing more is done; no action is taken—and India goes on her downward course. Now, we have no desire to quarrel with our Bengalee frie ds; but they ought to rememb r that Heaven helps those who help themselves, and that if they want the sympathy of Englishmen they must first deserve it. It is all very well to malign British Administration; but let any one of our good friends who are to be seen driving along the Strand with their barouches and pairs but cast one glance on the river before them, and then ask if Indians are doing for their country what they might have done and what they still can do. Let them look at those forests of masts, and they will see that the sarcasm of Sir Lepel Griffin is, after all, not unmerited. 'Nations by themselves are made'—so sings the author of the *Old Man's Hope.* Let our native friends but act up to it,—let them give up their hankering after twenty rupee clerkships and become carpenters and masons, hewers of wood and drawers of water —in short, let them learn that trade is the backbone of greatness,—and all the repressive measures of Anglo-Indian bureaucracy will not prevent them from becoming a great and respected nation. But, as we have often told them, they wil never become great by proxy, which is a fallacious endeavour.

ROYAL ENGINEERS IN INDIA.

THE problem of officering the Engineering Department of the army is one that seems never ending. The hard worked executive officers of the Public Works Department were driven to satisfy all these demands: those of the economist, those of the developer of the resources of the country, and of the strategist. And not content with that, another fiend appeared to worry and dismay—the Sanitary theorist. He proved the most expensive and vexing of all. No wonder, then, that, pulled to pieces by these different straggling energies, the executive broke down; but it rose up differentiated. New branches were started, notably the Military Works Branch. The birth of these new branches was not inaugurated without the costly human sacrifice; and Lord Mayo slaughtered, at the altar dedicated to the Secretariat oligarchy, the reputation and fortunes of half a dozen hard worked executives, who had not been able to cope with the impossibility evolved by the transitional state of the country. They were sacrificed on false representations. The famous Barracks that caused the outburst of secretariat wrath are still standing, and are let out as lodgings at this present time.

Notices.

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MR. E. A. DUKES, late MANAGER of MESSRS. W. NEWMAN & Co., LD., CALCUTTA, is now representing INDIAN ENGINEERING in the Upper Provinces.

CONTENTS.

Answer to Correspondents.

Several matters are unavoidably held over for want of space, but as we appear *weekly*, we hope to soon clear them off.

Obituary.

PORTER.—At Indore, on 28th, December 1886, Alfred Porter, late Sub-Engineer, P. W. D.,—aged 63 years.

NEPEAN.—At Rangoon, on the 3rd instant, at his residence, No. 30, Phayre Street, George Ernest Nepean, late Superintendent, Tawa Lock, Pegu Canal. Aged 41 years.

INDIAN ENGINEERING.

SATURDAY, JANUARY 15, 1887.

PROTECTION OF INVENTIONS AND DESIGNS BILL, 1887.

WE are glad to observe that a Bill to amend the existing Patent Law of India has just been introduced into the Legislative Council of the Governor-General. Experience in the working of the present Act XV. of 1859 has shown the existence of many defects which the new Law aims at remedying, and we have no doubt that those interested in Patents will welcome some of the changes that will be effected.

Among the principal alterations to be introduced, we observe that the new Act will include Designs, which heretofore have been protected by a separate enactment. The period a Design will henceforth be protected will be for 5 years instead of 3 years, while the Government Fee will be reduced from Rs. 100 to Rs. 10—a difference that will doubtless result in protection being availed of, whereas up to this time no Designs have been registered.

It is a great pity that while this new Act includes Designs or Part III. of the English Act of 1883, and adopts many of the essential provisions thereof, that it should omit Part II., relating to Trade Marks. For this there can be no good, or even satisfactory reason. To our knowledge, there have been many British, Indian, and Foreign manufacturers and dealers who have often enquired, and who are desirous to have their Trade Marks known by registration and subsequent publication as in England whereas now they have the *onus* of making them known as best they can by use and frequent advertisement, entailing considerable expense. To include this Part in the Act would not in the least prejudice or hurt the rights of the proprietors of well known or long used Trade Marks, as ample opportunity or sufficient time may be allowed them, say, a year from the commencement of the Act in 1888, to register their Trade Marks. The Government fee may be the same as for Designs, while the proprietors should be required either to pay the cost of, or to furnish engraved wood or metal blocks of their Trade Marks so that they may be published as in England. With this part included in the Indian Act a very considerable increase to revenue may certainly be expected to be realized.

While approving many provisions of the new Act, we regret much to notice that instead of a reduction as allowed for Designs, the new Act contemplates increasing the Government Fee for Patents from Rs. 100 for the full term of 14 years to Rs. 540 for the same time—the only concession being that it is payable in instalments

The object, it is evident, is to add to revenue, and were the payment fixed on a more gradual sliding scale, a fair result might have been expected. As the Bill stands, very few inventions will be protected beyond the term of two years, owing to the high fees thereafter required. Comparing the scale of fees of the two Acts, we find the initial payments of the Indian Act to be Rs. 10 on the application and Rs. 30 on the specification ; these, proportionally, are much higher than £1 on the application and £3 on

the specification of the English Act; besides the Indian Act only protects the Invention for two years whereas the English law protects it for four years or double the time, while the next payment of Rs. 75 before the expiration of two years raises it quite beyond double of the English Patent for the same time of protection, namely, four years.

If the new Patent Act has the object of aiding and developing Invention, as it presumedly has, the fees, especially the initial ones, should be considerably reduced; and it should be borne in mind that Inventors, especially the natives of this country—mechanics and artizans—are starving men, struggling with difficulty to meet their daily wants. Many of these have great inventive powers as shown in their many devices to save labour. With cheap protection for their Inventions, they might hope to expand them profitably. But, as proposed in the Bill, from being unable to meet the higher fees, their Patents—if taken out—must soon lapse, and as a consequence, they would be put to a considerable loss.

It is to be hoped that the Bill when considered in Council, will be greatly amended on the lines here pointed out.

THE EAST INDIAN RAILWAY UNDERTAKING.

We have received copy of a letter addressed by Mr. R. W. Crawford, Chairman, East Indian Railway Company, to Lieutenant-General Richard Strachey, C.S.I., a Member of the Council of India, on the subject of the working of the Undertaking during the years 1880—85, under the Purchase Act of 22nd December 1879. In it the writer proves conclusively by facts and figures, that during the past six years the Government of India has received from the business a sum close upon four-and-a-half crores of rupees as its share of the profit on the working of the Railway under the new contract. It is, moreover, shown that the financial success of the concern has enabled the State to make an advance of nearly two crores towards the enlargement and improvement of the property, without either raising a loan or applying to the tax-payers for relief. Calculating the interest on this provision at 4½ per cent., Government has received a sum of twenty-one lakhs in addition to about twenty-five lakhs, the interest on the value of the stores kept in hand. Coming to details, we find that the revenue receipts from all sources during the period were about twenty-eight crores, and the working expenses under all heads were nearly ten crores; the net receipts were, therefore, about eighteen crores. Out of these net working receipts the following sums have been paid: 1*st*.—The Annuity under the Purchase Act and all interest on Debentures and Debenture stock, on Debentures paid off, and on overdrawn Capital, about 12 crores; 2*nd*.—Interest on monies advanced on outlay for Capital purposes, over twenty-one lakhs; 3*rd*.—Interest on value of Stores in hand, nearly twenty-five lakhs; 4*th*.—Contribution to Provident Fund, about eighteen lakhs making a total of upwards of twelve-and-a-half crores—leaving for net profit five crores and forty lakhs, of which the Government of India has received four crores and thirty-two lakhs, and the Railway Company one crore and eight lakhs. In conclusion, Mr. Crawford modestly observes:—I do not write this in a spirit of boasting, or to invite controversy, but rather as a vindication of the broad principles which underlay the policy of 1879, in which you bore so large a personal share, and as a record of the magnitude of the interests involved in the prosperity of East Indian Railway Undertaking, to be borne in mind whenever any question of the resettlement of existing Systems may be brought under consideration.

STEAM-THRASHING MACHINERY FOR INDIA.

We have received a pamphlet issued by Messrs. Marshall, Sons and Co., Ld., containing particulars of their steam wheat-thrashing machine, which was recently tried at Bombay under the direction of Mr. E. C. Ozanne, Director of the Bombay Agricultural Department. Although we do not for a moment doubt the great advantages this country is likely to derive in the future by the introduction and more extensive use of steam machinery—especially in the development of its agricultural resources—yet, viewing the question broadly, we are not prepared to say that the time has arrived for the successful employment of steam in thrashing wheat, when we take into consideration the extremely low price of manual labour. Mr. Ozanne's report on the machine worked at the Bhadgaon farm, is entirely in favour of it, as is that of the Bombay Chamber of Commerce and the Bombay Flour Mill Co. on the grain thrashed. But the cost of the machine (Rs. 5,507) is, in our opinion, a very serious obstacle to its being utilized to any extent in the present state of the trade. The Messrs. Marshall very correctly observe that "the ryots are under the impression that they would not be able to procure higher prices for sending properly threshed wheat to the market;" but add that this is a fallacy, as English millers would only be too glad to get Indian wheat free from dirt and adulteration. This assertion is not, however, borne out by facts, as recently brought to light by Mr. Finucane in his report on wheat cultivation and trade in Bengal, to which we would draw Messrs. Marshall's attention. The action of the Bengal Chamber of Commerce in this matter does not encourage a hope that the steam thrashing of wheat will prove remunerative—at any rate at present—and we cannot, therefore, recommend the introduction of "steam thrashers" for India.

FERRO-CHROME.

It will be remembered that at the recent meeting of the Iron and Steel Institute, Dr. Percy, the President, in the course of his address, dwelt at some length on the advantages of using the metal chromium with iron and carbon to make the compound called chrome steel. He said that he had every reason to believe from tests which had come under his notice, that such steel would be found to possess all the hardness of high carbon steel, together with the toughness and malleability of low carbon steel. It is true that in the course of the subsequent proceedings Mr. Daniel Adamson, who also is an authority, threw some doubt on the possibility of attaining high tensile strength, without sacrificing ductility. It seems, however, that there is a disposition

amongst steel makers to try to the utmost what can be done. Already an alloy which has received the name of *Ferro-Chrome*, is being imported at Liverpool, and sample lots have been supplied to various works. The new material is in a condition analogous to that of ferro-manganese, it is an alloy and not an ore. The proportion of chromium which it contains varies from *nil* up to 50 per cent. The cost per ton for samples with about half the maximum proportion is about £30 per ton delivered to buyers' works. It will be interesting to hear how it answers. A very small quantity, not exceeding one or two tenths per cent. of metallic chromium in steel is said to have a marked effect in increasing its strength as well as its ductility.

Notes and Comments.

BENGAL-NAGPUR RAILWAY.—We are creditably informed that there is no truth in the rumour that the Secretary of State has sanctioned the making of the Nagpur-Bilaspur section of the Bengal-Nagpore Railway on the broad gauge, and that the Southern Mahratta terms have been granted to the undertakers.

BARRAGUNDA COPPER COMPANY.—We are informed that at the time we went to press in our last issue, the second operation—that of blister copper—had been begun by the Barragunda Copper Company at their works at Giridhi, in addition to the starting of the cupola for the production of regulus or the preparation of ore for the first smelting process.

RANIBAGH-RANIKHET ROAD.—The chief work under the head of Communications carried out last year in the N.-W. P. has been the military road from Ranibagh to Ranikhet, on which very substantial progress has been made. Its completion will connect the important military station of Ranikhet with the railway system of Upper India, and should add considerably to the traffic, both of goods and passengers, to be served by the Rohilkhand and Kumaun line.

COAL SUPPLY OF THE NORTH-WEST.—The opening of the first section of the Kutni-Bilaspur Railway to the Umeria coal-fields last week bids fair to revolutionize the coal supply of the North-Western Provinces and the Punjab. Umeria is 190 miles nearer to Allahabad than Giridhi, whilst to Jubbulpore the distance in favour of Umeria is upwards of 500 miles. This subject is at present exciting a good deal of interest in Upper and Central India.

TRAMWAYS FOR BENARES.—We understand that a London Company has received a concession to lay a system of tramways in Benares. The work will be carried out by a Calcutta firm. A hitch has occurred in the arrangements owing to the Municipality wishing to impose some impracticable conditions. The system will comprise three lines; one from Rajghat to Cantonments, another from Cantonments to the Purana Chowk, and the third parallel to the city.

PENNY-WISE AND POUND-FOOLISH.—We are informed that an order has been issued to the several branches of the Department of Public Works directing Engineers, whenever they require *teak*, to send their orders to the Bombay Burmah Trading Co. and to deal with no other firm. This order for curiosity somewhat resembles another that strictly lays down that all English materials required, in indents for the Department, when exceeding the sum of Rs. 10, must be sent to the Secretary of State, and should be anticipated twelve months before the articles are required so that there may be sufficient time to comply with the requisition.

KASHMERE STATE ROADS.—We are informed that wiser counsels have prevailed, and that the Government of the State of Kashmere are moving actively, as regards co-operating with the Indian Executive in the matter of roads extension and connection. The Durbar have already sanctioned an allotment of Rs. 3,60,000 for the current year for these undertakings, and there is every probability of the work being pushed on as rapidly as is desirable in interests of both British and native territory. We may incidentally mention, that the Railway surveys are in an advanced stage, but nothing has been decided yet as to the exact route that will be adopted for a line to Sirinugger.

THE RESIDENT ENGINEER-SHIP OF THE KIDDERPORE DOCKS.—Professional opinion in the Lower Provinces is much exercised as to whom the prize of the Resident Engineership of the Kidderpore Docks will fall. The favorites are Messrs. Apjohn and Buckley, and the odds are pretty evenly balanced between them. They are both in the same grade of the P. W. D., but Mr. Apjohn is a few months the senior in service. Mr. Buckley is a Whitworth Scholar, and Mr. Apjohn an Irish Graduate in Arts. They both belong to the same branch of the P. W. D., and have distinguished themselves in the walks of Professional Literature. So that, whichever may be selected, the choice will be a good one.

SUBSTITUTION OF EUROPEAN FOR INDIAN PURCHASES.—The advantages of the system of obtaining stores through the India Office, in lieu of the system of local purchase, is well illustrated in the instance of the Madras Survey Department, which sent Home for a number of theodolites, chains, and plane tables for the use of certain Survey parties in actual need of them. The Superintendent of the Survey, in noticing a few instances of long delay in receipt of these stores from England, says that the articles included in his indent, dated 28th January 1884, were received between the 3rd June 1884 and the 10th January 1885, and in that dated 27th January 1885 from July 1885 to 11th March 1886, while theodolites indented for on the 27th January 1885 were received only in July 1886.

MADRAS COLLEGE OF AGRICULTURE.—We glean from the last annual report that there were 92 pupils in this institution at the beginning of the year, and 86 at its close, and that representatives of all nationalities of Southern India may be found among them. The expenditure exceeds Rs. 42,000, while the receipts are comparatively infinitessimal. The information given regarding the employment of passed students proves conclusively that young men who have been educated at Saidapet have no difficulty in finding remunerative employment. With the impulse which is sure to be given to agricultural education by the technical education scheme, it may be anticipated that, along with other special institutions, the college will year by year contribute a larger share to meet expenses.

UMBALLA-SIMLA RAILWAY.—It is believed that besides the Military offices the majority of the Departments of the Government of India will be permanently located in Simla. Should this be the decision of the Government, it is probable that the construction of the Railway from Umballa to Simla will be begun at an early date. Hitherto the principal reason for not having adopted either of the

three schemes sent in, is said to be, that the line would not be a financial success. Remuneration could not have been thought of when erecting those monumental structures in Whitehall or the costly buildings in this country, else the profusion of ornament and luxury they display would never have been indulged in. The Annual Allotment for their maintenance, &c., amounts to a sum which would more than cover the interest on the required Railway outlay.

THE G. I. P. R. BOMBAY NEW TERMINUS.—The *Times of India*, in its review of the past year, says that early in the year the new terminus of the G. I. P. Railway was thrown open to the public, and that it is, without doubt, the finest modern building in India, as well as one of the handsomest Railway stations in the world. The Directors of the Company have good reason to be proud of the workmanship of their architect, Mr. F. W. Stevens, and it is generally hoped in Bombay that the Government of India will see their way to give him one of those honorary distinctions with which the higher officials are somewhat too fond of decorating one another. We may add, that the new Terminus includes the Administration Offices of the G. I. P. Railway at Boree Bunder, which are the largest of the kind in India, and will cost 27 lakhs when completed.

NAVAL DOCKYARDS IN THE EAST.—We glean that the result of the consideration given by the Board of Admiralty to Sir John Coode's reports has been to determine it to begin at a very early date with the construction of a dock at Bombay, suited to the reception of the largest of our ironclads. It is considered that further accommodation should be also provided for H. M.'s ships in Eastern waters either at Trincomallee, Colombo, or Singapore. It is believed that Sir John Coode favors Colombo, but one of the Dock Companies at Singapore has forestalled the Ceylon capital by offering to the Admiralty to construct a dock at that port to fulfil all official requirements. It is unfortunate for either Colombo or Singapore that the Ramiseram Canal Scheme should have been brought forward at the present moment, when it is acknowledged that the proposed canal would afford a thoroughly safe and well-sheltered port where such a port is most needed.

A CONDITIONAL CONCESSION.—The Madras Government have resolved to make the Madras Municipality a grant of Rs. 1,00,000 on condition that the whole of this sum is employed on the Black Town drainage scheme, but insist that the full amount (Rs. 1,84,000) budgeted for in connection with the said scheme must be spent during the year 1886-87, as well as any balance that may have been left unspent from the allotment of 1885-86 (Rs. 1,57,770). If this is done, the total expenditure on the work up to the end of the year 1886-87 will amount in round numbers to Rs. 7,71,400, of which Rs. 91,800—the excess over the amount borrowed up to date—can be met from the lakh now granted. The remaining portion of this grant (Rs. 8,200), together with any sums that may not be expended out of allotments to the end of the current year, must be spent on the drainage work in 1887-88 The original estimate for the scheme was Rs. 8,07,500, but there appears to be every probability of this being largely exceeded, and accordingly it will be necessary for the Municipality to contract a loan in the open market next year in order to complete the work. The Government fully concur in the opinion that the cost of these works should be met from capital raised by loan.

Current News.

THE reconstruction of the Mandalay Bund commences immediately.

COLONEL RAOUL DE BOURBEL, R.E., on special duty in Cashmere, is retiring from the service.

LIEUTENANT G. M. HARPER, R.E., has been placed under orders for duty in the Bengal Presidency.

A TELEGRAM from Burmah announces that the Ruby Mines were occupied on the 27th ultimo, without resistance.

THE Kidderpore Dock works, which are being pushed forward with great vigour, give employment to over 2,000 coolies.

A SPECIAL loan will probably be floated for the Toungoo-Mandalay Railway, the capital required being about two millions.

THE Nizam's Government has issued orders for the erection of a commodious jail at Aurungabad, the present building being insufficient to meet local requirements.

MR. BRADFORD LESLIE, Agent of the East Indian Railway, has arrived in Calcutta, much benefited by his sea trip, and took overcharge from Mr. Campbell, who has rejoined his appointment at Jamalpore.

MR. GUILDFORD MOLESWORTH has returned to Calcutta from Burmah, where, as recently stated, he went over the whole length of the proposed Toungoo-Mandalay Railway, which he considers likely to be highly successful.

MOGOUK, the Ruby Mines centre, is described as a flourishing town, made up of four villages situated in a narrow and most picturesque valley. The mountain portion of the path to Sagadoung is still extremely difficult for loaded animals.

THE promoters of the Nagpore-Bengal Railway scheme want four per cent. guaranteed for 10 years, and the India Council offer that rate for five years only, with a subsequent guarantee of 3½ per cent. Government taking ⅘ths of the surplus net profit.

MR. EDGAR TAYLOR, of Messrs. John Taylor and Sons, the mining firm that has taken a leading part in the development of the Colar Gold Field, is expected in Madras by the next P. and O. steamer from England. He will conduct a close examination into the field.

THE total area of forest land in Assam on the 31st of March 1886, was 9,586 acres, of which 2,332 were reserve forests, 862 protected and 6,392 district forests. The expenditure for the year was Rs 2,11,494, and the receipts amounted to Rs, 1,96,656, which leaves a balance on the wrong side of the account.

THE report of the Telegraph Department for 1885-86 mentions that during the year several cables of unusual size and strength were laid in Bombay harbour. This work, which was novel and difficult, was carried out very successfully by the executive officer, Mr. S. H. C. Hutchinson, Assistant Superintendent.

A FATAL accident occurred on the 5th instant on the South Deccan Branch of the Southern Mahratta Railway, by which five lives were lost—one European fireman, one cleaner and three other natives. The accident was caused by a construction train running over a buffalo, whereby all the carriages were derailed.

A RESOLUTION has been passed empowering the Directors of the Madras Railway to enter into a contract with the Secretary of State for India, for the transfer to him by the Company, on such terms as may be agreed upon between them and the Secretary of State, of the branch line (about thirty-two miles in length) from Guntakul to Bellary.

THE Educational Department obtains a second C.I.E, and Mr. Kipling, late of Bombay and now of the Lahore School of Art, is the lucky recipient. Nobody will grudge Mr. Kipling his well-earned decoration. Together with the other gentlemen who were the making of the Indian portion of the Indian and Colonial Exhibition, he had been ignored at home. A crying injustice has been retrieved in his case, and later on we trust that the two or three other gentlemen who prepared the chief Indian Courts will receive the same acknowledgment as Mr. Kipling.

ANOTHER trial of four different kinds of cast iron ploughs was made on the morning of the 5th instant near the Beerity railway station in the presence of Colonel Neill of the Public Works Department, Mr. Finucane, Director of the Agricultural Department of Bengal, Messrs. Sen and Mookerjee of that department, and the Superintendent of the Burrakur Iron Works. A large number of cultivators and native gentlemen had assembled to witness the trial. It was found that some further improvements are necessary to make these ploughs suit the cattle of the country.

THE report of the Directors of the East Indian Railway Co., referring to the Hooghly Bridge, states that the Directors have been in communication with the Secretary of State upon the subject of the access of the Company to Calcutta after the opening of the bridge. After mature consideration, the Directors have resolved to waive for the present their former proposal for separate access to Calcutta by a line under their sole control, but they entertain a confident hope that they will be able to make arrangements with the Secretary of State for India for running powers over the Eastern Bengal Railway line, on terms which, they say, will allow of the development of the purpose that they have always kept in view in the construction of the bridge.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

DISTRICT BRIDGES.

SIR,—In one of the articles which appeared in the first issue of your journal, Mr. Geo. Anderson, Local Fund Engineer, Malabar, discloses a state of things in regard to the science of bridge building in Malabar, which is typical of every district in Bengal and Behar. "No sooner," says Mr. Anderson, "is one bridge built than another falls, or is condemned as unsafe." He estimates that at least one hundred such bridges have been built within the last quarter of a century, which have nothing left but their abutments. Every district in Bengal shows the same sad waste of money and energy. A recent case of failure of this kind occurred in the Gya district, which seems to call for a notice in your journal. The District Road authorities of Gya, as I am told, took it into their head to bridge the Falgoo river with timber piles and platform. I need scarcely say that in the District authorities I include the Engineer and the controlling authority, as it would be unjust to lay all the blame on the shoulders of the few members whose ambition it was to bridge a torrent with the limited means at their disposal. The Falgoo being a hill torrent choked with sand, no contraction of its bed would be admissible, and it would be difficult also to sink the wells to a sufficient depth to escape scour. It may be imagined that the bridge under notice must have been defective in both these respects, and has, therefore, been partly destroyed by scour.

A curious fact has come to my knowledge—that the *koond* (pool) formed on the site of the destroyed bridge is just what is wanted in another part of the river for providing water for the pilgrims for bathing purposes, for which the Pilgrim Committee (only slightly different from the Roads Committee) is prepared to spend Rs. 20,000 for making a pool or *koond* at the sacred spot where there is nothing at present excepting black dirty water, the sight and smell of which would drive away all but the religion-thirsty Hindoo pilgrims. Like the wings of Prince Rasselas, the fate of the timber bridge at Gya should at least teach the people of Gya how to obtain a *koond*.

Though not fully acquainted with the details of the case, I presume they want at Gya a bridge for crossing the Falgoo river at high floods which continue for some days, and the force of the current is said to be so strong as to make it impossible to cross in a boat. The depth of water at floods is not much, and at other times the river is nearly dry, and the people get their drinking water by digging holes in the sand. Stone for building purposes is close at hand, sand of the finest description for mortar is in the river bed, and excellent *kunkur* lime is cheap and plentiful. Bricks can also be made at some cost. With the above facts before you, Mr. Editor, yourself or some of your readers could devise a scheme that would meet all the wants of the people and that would itself be a permanent undertaking, deserving of the name of *engineering*.

Perhaps you would expect me to offer a suggestion, too, though after the loss of the money it would not be worth much. Still I would say that the bridge should be built near bathing ghâts—the most crowded parts of the town. It should consist of masonry piers built on wells sunk to reach firm soil or rock, the timber of the present bridge being utilized for the superstructure. Such a bridge would always cause a scour under it, which would leave a perennial *koond* or pool for bathing purposes, and the *Koond* or Pilgrim Committee, I presume, would gladly contribute towards its construction.

Your correspondent "J. N. C." has not given sufficient details of the Kosi bridge to enable a criticism. Is it a Railway bridge or a Road Cess bridge ?

Mr. Editor, now that your journal gives the means of criticising every engineering project, such as I have noticed above, we should no longer be satisfied with crude attempts at engineering feats, the failures in which are mostly condoned and are not brought to light. There should be an attempt made to bring every project within the scope of professional criticism before being carried into execution.

Seeing that bridges invariably fall, or are condemned, our Engineers have adopted the opposite policy of *bunding* up rivers and *khals*, resulting in disastrous consequences when such *bunds* are breached, and when they are not breached the fields in the background of the *bunds* get deeply inundated and crops suffer or diseases break out. With the supply of funds engineering in every district becomes the source of weal or woe to the people, and requires the aid of a journal like yours to enhance the chances of its success and to prevent failures. R. R. M.

OIL-GAS FOR INDIA.

Sir,—In reference to the article 'Oil-gas for India' in the first issue of the INDIAN ENGINEERING, I am astonished to see that Mr. Carrier, an old resident of Burmah, seems to claim a patent for the whole of India. India was lit with oil or petroleum gas when Mr. Carrier had not conceived such in his brain. Jeypore Oil-gas Works exists since 1875. Hyderabad Public Gardens were lit with the same two years before that, and the Rawal Pindi Military Barracks were lit with the same gas, I believe, since 1870. It is, no doubt, a far superior gas than coal-gas, but as long as the Rangoon Oil Co. will work in the same sleepy way as up to now, and as long as the Railway Companies will have their prohibitory freights for these oils, there is little hope for any Oil-Gas Company to be successful.

S. J. JELLERY,
Supdt., Gas Works, Jeypore.

Literary Notices.

GEOLOGY : CHEMICAL, PHYSICAL, AND STRATIGRAPHICAL. *By Joseph Prestwich, M.A., F.R.S., F.G.S., Correspondent of the Institute of France, Professor of Geology in the University of Oxford.* In two Volumes. Vol. I. Chemical and Physical. Oxford : At the Clarendon Press 1886.

THIS work is a general treatise on Geology adapted both for elementary and advanced students. Vol. I., which is issued in Royal 8vo., pp. XXIV, 477 (with Maps and Illustrations), treats of questions in chemical and physical Geology, and special attention is paid to such subjects, among others, as Hydro-Geology, the geological bearings of the recent deep-sea explorations, Volcanic action, joints, mineral veins, the age of mountain ranges, and metamorphism. Vol. II., which is far advanced, will treat of stratigraphy and palæontology, and will touch upon various theoretical questions. The author advocates the *non-uniformitarian* views of geology.

TREATISE ON VALVE-GEARS. *By Dr. Gustav Zeuner* of Zurich. Translated by Professor *J. F. Klein* of Lehigh, University, U. S. A. London : E. and F. N. Spon.

THE importance of the economical effect of using steam expansively cannot be over-estimated in this age of mechanical progress, and much of the advance made in this department of the steam engine must be ascribed to the departures in British practice initiated by Fairbairn and others. The mechanical arrangements of the different modes of intercepting the steam between the boilers and the slide valve, are as numberless as they are diverse. The main consideration being always the same, the differences between various makers only resolve into minor deviations from one general arrangement of valve and gear universally adopted; and, as the principle of action is constant, it has been found susceptible of mathematical treatment. It is for theoretical discussions of this class that Professor Zeuner's "Treatise on Valve-motions" commends itself to our attention, as embodying investigations that are alike novel and useful. He first considers valve gears with one side slide valve, and afterwards deals with those having two valves, and says that the whole problem to be solved in connection with both simple and complex valve gears, may be briefly stated to be: "The analytical or graphical determination of the relation between the piston position and the valve position (movement)." This, expressed analytically, implies that "the piston position and valve position can be represented as functions of the crank angle, and, combining both equations and eliminating the crank angle, we get the direct relation between the piston and valve positions." It should not be inferred from these abstruse passages that the work is devoted to mathematical investigations alone. The author gives many examples of the practical applications of the principles deduced, and extends them to problems of everyday occurrence in the designing of machinery. His section on Link-motions is particularly complete, and it is supplemented by a descriptive account (at the end of the book) of the principal works on the subject, which, being mostly foreign, can well explain the desirability of a translation of Professor Zeuner's work, which presents the substance of them all in a condensed form.

It should be noticed that in the second part of his book Professor Zeuner exhausts the treatment of double-slide valves, by discussing all the double valve-gears which are of interest and importance from the theoretical and practical stand-point. This, like the other part of the book, is very comprehensive, and, as far as the mathematical portions are concerned, is elegantly written. It was these points of excellence that ensured for Professor Zeuner's work a wide circulation and general acknowledgment in Germany, and we have no doubt that the excellent translation here reviewed will secure the same success in England and America.

General Articles.

RANGOON DRAINAGE PROJECT.

Shone's Hydro-Pneumatic System.

(Continued from last issue)

The project which we have the satisfaction of submitting to you for the drainage of the Sewage of Rangoon admits of this being done in the most simple and efficacious manner possible.

You will have perceived already, from reading the title on the drawings which accompany this Report, that we propose to adopt the "Shone Hydro-pneumatic System of Sewerage." This system has for its object the speedy and consequently sanitary collection of what is known as the English water-carried sewage within town areas, and the equally speedy and sanitary ejection of the sewage without town areas, so that it shall neither be offensive to the smell nor dangerous to the health of the population discharging it from time to time. These all-important desiderata are accomplished as follows: small gravitating drains and sewers are conducted in the first instance to carry the sewage to Pneumatic Ejector Stations as rapidly as it is discharged from the houses.

These Pneumatic Ejector Stations are distributed over the town or district to be drained, but every station is always so fixed that it shall be able, by reason of its depth below ground, to command the greatest area which, after careful levelling, can be found to be drained by it. They are generally placed where four streets meet, and care is always taken to insert them before the gravitating sewers which supply them with sewage attain to inconvenient depth. In this way unnecessarily heavy expenditure in the construction of deep-seated sewers is avoided. Not only is this the case, but every gravitating sewer coupled up to the Pneumatic Ejector Station can be so designed and constructed on the Shone System, that when the sewage enters them it cannot fail to flow to the Pneumatic Ejector Station at the velocity required to render the sewer conveying it permanently self-cleansing. The Pneumatic Ejectors receive the sewage as fast as it flows from the population yielding it, and as they get filled compressed air ejects the sewage out of them automatically. The ejecting power—the compressed air—exerts itself only when it is required to be exerted, the moment the sewage contents of the Pneumatic Ejector are ejected, that moment the compressed air power ceases to operate and to exert itself. It performs the functions of a sort of sanitary aërial policeman. It permits the sewage to flow to it, but it will not permit the sewage to stand at it and to become a nuisance. As already stated, the power employed to actuate the Ejector is compressed air. This may be compressed by a water-wheel turbine, or other hydraulically driven machine. In the majority of cases it is compressed by steam power. What the engineer has to do to apply the Shone System to the collection and propulsion of sewage is to take care to provide machinery and power enough to compress all the atmospheric air required to such a degree of tension as will be sufficient to eject to the outfall the greatest quantity of sewage which will proceed from the population at any one minute or time of the day, because sewage discharges like coal gas and water supplies, as is well known fluctuate in their hourly volume, and are much greater at times than at others. The air compressing engines or plant can be fixed in any situation which may be most conveniently allotted or bought for the purpose.

It is immaterial whether the site of the air compressor is on a hill or in a hollow, but, for the sake simply of shortening the length of the air-pipes which convey the compressed air to the several Pneumatic Ejector Stations, on the score of economy in first cost, the more central the air-compressing station is the better. On the other hand, if the placing of the compressing station in a central situation involves a heavier outlay in the purchase of the site than in the purchase of the air-pipes, &c., consequent upon the erection of the air-compressing station elsewhere, then, in such a case, the engineer need not insist upon erecting his air-compressing plant in the most central situation possible.

We hope what we have stated in the foregoing pages will be sufficient to satisfy you—firstly, that gravitation drainage *per se* in flat or *low*-lying towns especially is, if sanitary conditions are to be as they ought to be a *sine quâ non*, impossible of accomplishment; and, secondly, that by the adoption of the Shone System of drainage a most scientific and practically complete sanitary plan of town drainage can be carried out, the untoward natural conditions as to the flatness or lowness of the surfaces built over notwithstanding.

We will now proceed to explain our project for the Sewerage of Rangoon on the Shone System. To enable you to clearly understand our proposals, we have prepared drawings to accompany our Report; those marked respectively Nos. 1, 2, 3, 4, 5, 7, and 8, relate to our Sewerage project.

Drawing No. 1 is a skeleton map of Rangoon, showing as much as is sufficient or necessary for our present purpose. The "Reference" on the drawing is self-explanatory. It will be observed that besides showing proposed works of sewerage this map also shows our project for the high-pressure water supply service.

We will, however, first of all, describe our sewerage project, but later on we will revert to and describe our high-pressure water supply project.

On the Drawing No. 1 will be seen the situation and number of the Pneumatic Ejector Stations, gravitation sewers, &c., required for the complete drainage in the first instance of the town proper. Within the area occupied by the town proper it is proposed to sink and construct no fewer than 22 Pneumatic Ejector Stations, the whole to be supplied with compressed air from the air-compressing station marked upon the drawing, and which is situate at the junction of Dalhousie and Judah Ezekiel Streets. The houses and properties in the immediate vicinity of each Ejector Station will be drained of their sewage by the Ejectors nearest to them in the manner indicated on the drawing. The sewage discharges will be thrown by the producers into the system of gravitating iron sewers shown in red on the drawing, and which will be connected with the Pneumatic Ejector Stations. When the sewage will pass into these, the superior inclination given to them throughout their entire length will have the effect of causing the sewage to flow freely by gravitation power down to the Ejector Stations; and as the distance to be traversed by the sewage thus dealt with will in every case be short, the furthest house away from the Ejector Station not being more than 1,100 feet, it is manifest that by this arrangement good scientific and practical conditions for securing the speedy despatch of the sewage from the houses to the outfall are secured; the outfalls in these instances, in so far as every house is concerned, being the Pneumatic Ejector Stations. A diagram on Drawing No. 8 (to follow) will illustrate the way in which the internal drainage arrangements will work. The outfall for the whole town in the aggregate, however, under this project will be the same as that which had been fixed on at Monkey Point in connection with the gravitation project already submitted to the municipality by Mr. O. D. Clark, C.E. But there is a great and very important difference between the main outfall sewer proposed under Mr. Clark's gravitation project and the main outfall sewer proposed under this project. The former, as its name implies, is a gravitation sewer, which would be laid at great depth; but the latter is a small sewer, laid near the surface, and easily accessible for repairs, &c. It will always be more or less under pressure. The former would never be free from sewage gas, however perfect the ventilating arrangements might be, because the fluctuations in the height of the sewage within it would alternately expose and cover surfaces wherefrom sewage gases would be emitted, and these would find their way into and vitiate the air of the town. In thus condemning such an outfall sewer, we desire to say that

PLATE. II

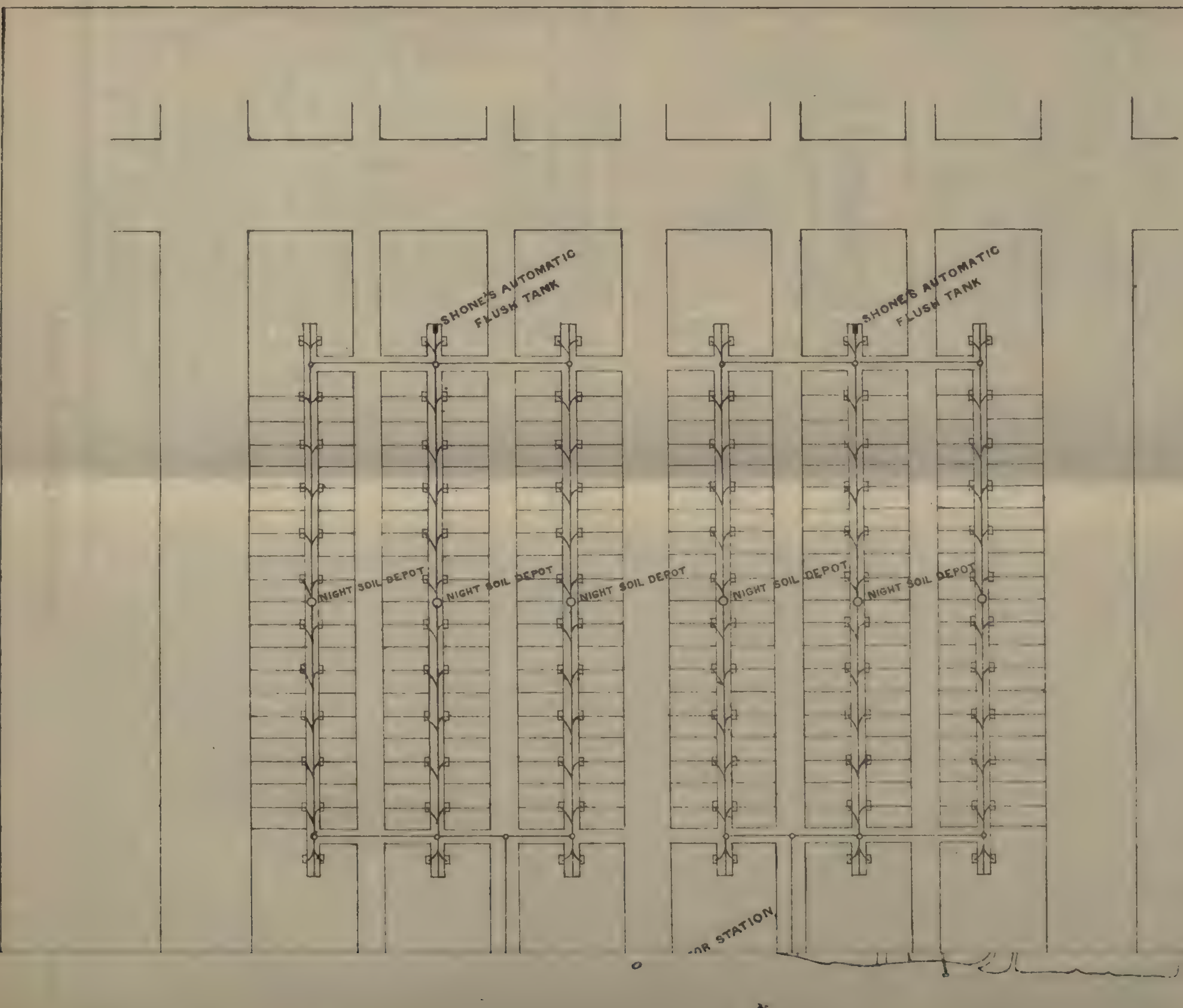


FIG. 1

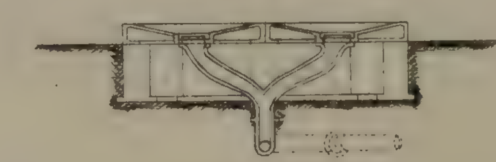
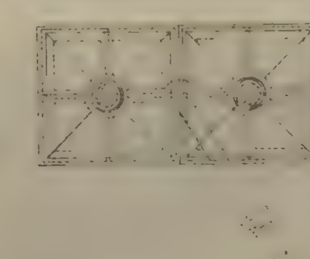


FIG. 2



SCALE : 1/4 INCH TO A FOOT

PROJECT FOR THE SEWERAGE

AND

SUPPLEMENTARY HIGH PRESSURE WATER SUP

until the Shone System turned up, the leading engineers of England had no other better plan for dealing with low-lying and tide-locked towns. Wherever cases such as that which presents itself at Rangoon have occurred, projects for dealing with them have always been forthcoming, but each in its turn has been in principle and more or less in detail also on the lines of the project prepared by Mr. Clark. Of course the construction of such an outfall sewer for town drainage purposes would be infinitely better than making no provision at all for the removal of the sewage, especially in a town with the soil and climate which are peculiar to Rangoon. The outfall sewer used in connection with the Shone System, however, being made of iron, and intended to carry the sewage to the outfall under pressure, "can be laid at any depth and at any inclination which can take any curved or other required form, which can ascend hills or descend into valleys, which will neither leak from within nor receive from without, and which can in general be laid along public highways and so avoid interference with private properties, which neither require objectionable ventilators nor any other outlets;" and whether the tide was high or low at the one outlet in the river at Monkey Point, the sewage collected at the 22 Ejector Stations in the town proper would be ejected into our outfall sewer at each of these stations, as fast as the various Ejectors got filled from time to time. In this way the sewage of one section of the town can never become a nuisance and a source of danger and annoyance to another section of the town. The sewage collected by properly inclined sewers of small bore at Station No. 1 is at once ejected into the iron outfall sewer which communicates with the Ejectors in that station. That sewage once it is in the outfall sewer is confined within that sewer until it reaches the outfall.

(To be continued.)

COKE MAKING AND COLLECTION OF TAR IN BENGAL.

(Continued from last issue.)

Now that coal tar making has become a recognised industry in different countries in Europe, I know of no locality more suited for the developing of coal tar industry than some of the Bengal collieries, and it would very well repay any Company having coke works to introduce the recovery of tar, which operation could be introduced even at some of the smallest collieries by making the coke in closed small ovens. Several systems of closed ovens for collecting tar are used in England and France.

In France one of the best systems on a large scale for the collection of tar and bye-products is the Simon Carves' closed ovens.

This system gives the best outturn of coke, which is decidely the best in quality in the English market for iron smelting, made from same coal in any other class of ovens.

The outturn at some of the leading collieries is as much as 77 per cent.; this compares more than favourably with our Bengali ovens, the outturn of which is usually 25 to 30 per cent. only; besides this good outturn all the bye-products are collected, which gives the Company who work these ovens, from 6 to 9 shillings per ton on the coal used. The profits from the above are more than what some of the Bengal colliery owners get for their best steam coal at the collieries. Also, I may add to this, that the coke is worth 2 to 3 shillings per ton more to iron smelters than any other in the market.

Some of the bye-products from tar are very dear in India. I refer now to aniline dyes, ammonia, acids, lubricants, and many other chemicals made from tar as the result of recent discoveries.

Coals found to be very rich in the above substances are now worked in some of the Bengal coal fields.

The last mentioned ovens would suit large collieries and give large profits. For small collieries I would recommend a system of coking by retorts, like what are in general use in gas works, only made more simple and not under very heavy pressure. They would not be very expensive, the owners could get a better outturn of coke in *quality*, and *quantity* also; all the tar would be collected, which could be sold to any Company who would take up the type products' industry. There seems to be a general idea, that there is no market for tar or what it contains, hence no one takes the trouble to give it a fair consideration.

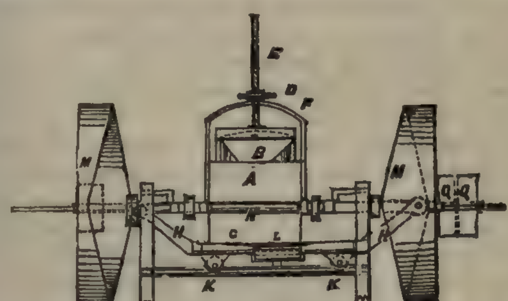
We know that there is a great demand for lubricants for machinery and railway rolling-stock, also for pitch and creosote; and all these are very easily extracted.

If our friends, the Germans, would open out chemical works in some of the colliery districts of India like what they have in Europe, it would be a very good speculation and would well repay them, and do a deal of good likewise —opening out a new field of industry and source of profit from what is now allowed to waste in smoke.

F. L. C.

GALLON'S IMPROVED TEA ROLLING MACHINE.

The advantages claimed by this appliance, which is described below are: simplicity in construction and working, absence of friction, and direct application of the power to the required purpose, comparative cheapness, durability, cleanliness, and efficiency.



The illustration shows a box or chamber (A) to contain the charge of tea to be rolled. The said box or chamber may be made of wood, glass or slate, and may have a wrought or cast iron frame with arms or projections for the attachment of connecting rods; to ensure the travel of the box in a horizontal plane, one or more guides may be attached to the frame work. The said arms or projections may be prolonged to slide in the said guides or to carry small rollers or wheels.

The hopper (B) may be made of wood, wire gauze, or light tinned sheet iron, and may be either fixed or moveable.

The lid of box or chamber may be made of wood, glass or slate, concave on its nether surface, and grooved or corrugated. The hand wheel (D) geared into the screwed spindle (E), passing through the bearer (F) raises the lid (C) and admits the charge of tea.

The spindle E may be screwed to an easy pitch, so that the lid, being weighted, may automatically follow the tea as it is reduced in bulk by being rolled.

The plane or table (G) may be made of slate, glass, wood and iron, or any combination of two or more of these materials, and may be concave on its upper surface with grooves or corrugations, and with or without a provision for an opening (L) for the downward discharge of the rolled tea.

The revolving of the fly-wheels (M M) gives a right line alternate motion to the said plane or table by means of the bevelled rims in contact with small wheels or rollers in the extremities of the projecting arms (H H). Light rails are attached to the framework, on which the plane or table travels on four wheels, two of which are shown and lettered (K K).

The wheels or rollers may be omitted from the arms H H, and the motion obtained by frictional contact. The rails may be omitted, and planed guides substituted.

The crank shaft (N) gives a right line alternate motion to the box or chamber (A) by means of the connecting rods. Crank handles are attached to the fly-wheels of machines for hand power, and (Q Q) are fast and loose pullies for machines for steam or other motive power.

One fly-wheel and one projecting arm may be dispensed with by cutting a groove in the other fly-wheel to the line of the bevelled rim, and attaching a guide to the remaining projecting arm which shall travel in the said groove; two machines may be worked by one fly-wheel.

ON BREAKWATERS.

Breakwaters may be divided into three clases—(1) those which are entirely rigid as far as the material admits, (2) those which are as flexible as the connections admit, (3) a combination of the first two classes. The construction of the second type has only been suggested in late years. The construction of the third type is, perhaps, here suggested for the first time. Breakwaters of the second type have, I think, not yet been actually constructed. By a flexible breakwater is meant, for example, a series of rows of buoys—each row being, say, parallel to the coast line. A wave impinging on the first row would pass through with diminished force and reach the second row. Finally, it would reach a certain number of rows, and would be spent in the process. This "flexible" principle is thoroughly sound, and when Engineers have given the subject a proper degree of attention, highly satisfactory results may be expected. But in the present article the rigid breakwater will alone be considered.

If we were to choose the site of a maritime town from landward considerations, we should ask for flat country in the neighbourhood to facilitate the transit of goods. At the mouth of a great river we usually have flat country. On the other hand, the site is generally chosen with reference to harbour accommodation and without reference to the land behind. Now, the flat countryside and the excellent harbour are likely to be conflicting conditions. For, if the sea retired from the harbour bold hilly country would be exposed. The character of a country generally changes gradually. The coast line is—so to say—an arbitrary line drawn across the grain of the scenery. If the land mounts steeply up from the shore, we expect deep water close to the shore. If it is nearly level for some distance inland, we expect shallow water for some distance seaward. Thus—to come to the point—it will often be advantageous to create a small harbour exactly where nature had never thought of placing one.

A *breakwater* is simply the attempt to make an artificial harbour. A breakwater should fulfil one condition, and one only. It need not be cheap, but it should be *durable*. We can afford almost any sums to build a breakwater, if we can be sure that it will remain and be effective.

The crudest idea of a breakwater which the mind can picture, would be simply a vertical wall resting by its weight on the ground beneath the water. Incredible as it may appear, a breakwater was not long ago built on this principle—or rather absence of principle—for an important place in India. Such a breakwater is indicated by a vertical section at right angles to the shore line in fig. 1. The slope of the sea-bed is not indicated. As long as the sea is smooth, we may take the pressure from S the seaside to be balanced by the water pressure on L the landside. But a breakwater being presumably constructed entirely with a view to rough weather, we must consider the effect of waves advancing from the sea and striking on the face C B. If the wall is not broken up, it tends to be overturned about the line whose projection is the point A. Such a wall, in fact, is simply a challenge to Neptune—"Knock me down if you can." In the case referred to above, Neptune promptly accepted this challange. Disdaining to put forth all his strength, he sent for a moderate storm. Next day, the *disjecta membra* of the wall were strewed over the roadstead, and the last state of that place—for ships—was worse than the first.

Let us now consider whether some elementary science could not have prevented such waste of time and money. In fig. 2, A C B is a vertical section of a different style of breakwater. The slope of the sea-bed is again omitted. The characteristic of this shape is that the angle C is a right angle. There would be no objection in theory to the angle being made obtuse, but the expense of construction would be greater and the right angle sufficiently answers the purpose. Neglecting water friction, the pressure on B C is at each point, P or Q, normal to the face C B. That is, it is parallel to the face C A, and no matter how great these normal pressures—or normal blows—may be, they have no tendency to overturn the structure about the line through A. In fig. 2, we may suppose the inclination of the face C B to be made less. Then the face C A will become more steep. The volume of the structure will then be increased, and the expense of construction will increase in a greater ratio than does the volume. To determine accurately the least volume possible, we may take account of the slope of the sea-bed. For the plan of tumbling in loose materials to make a level base and constructing the breakwater to rest by its weight only on that made ground, is unscientific, and has, of course, proved unsatisfactory.

In fig. 3, let A B—the section of the sea-bed—make an angle $90°—a°$ with the horizon. Let H be the point chosen for the ridge C to be above H. The height C H will also have been chosen, and is, therefore, a given length h.

The figure shows that $\frac{CA}{h} = \frac{\operatorname{Sin} a}{\operatorname{Cos} \beta}$; $\frac{CB}{h} = \frac{\operatorname{Sin} a}{\operatorname{Sin} \theta}$

$\therefore$ area of $ACB = \frac{1}{2}. CA. CB = \frac{h^2 \operatorname{Sin}^2 a}{\operatorname{Sin} 2\theta}$

Therefore the minimum value of the sectional area at any point—and therefore of the volume of the whole structure—will be given by $2\theta = 90°$. Thus each face should meet the sloping sea-bed at an angle of 45°. This would give the cheapest (and yet effective) shape.

We have hitherto assumed that the face C B is plane. In fig. 4, we now replace the plane face by a concave face C D′ B. For points like D′—near to the base—the normal water pressures are made more vertical than they would be for corresponding points D. This, so far, is an advantage. But the water pressures near D′, though statistically the greatest, have no overturning tendencies and thus are not important. The water pressures at points near C become more horizontal and so will have lines of action which meet B A produced. These forces will, therefore, exert some leverage to overturn the breakwater about the line through A. The concave facing is, therefore, on the whole an evil.

In fig. 5, we have shown a convex facing in substitution for the plane face C B. For important points near C, the lines of action of the normal water pressures or wave blows are made to approach more closely to the vertical, and this is useful. Thus, we arrive at fig. 6, which gives the ideally perfect shape of the section. This is a *semicircle*, and one glance at the diagram will convince any one who has a knowledge of mechanics, that it fulfils all the necessary conditions in the most perfect degree. In practice, the curves B D C and A E C might be replaced by curves of less curvative, or the inward face A C might be left entirely plane.

Finally—not to make this article too long—we will notice one more point only. In fig. 7, we have a plan of the breakwater. We may suppose it to have a crescent shape so as to enclose some part of an unprotected coast line. X Y will be the main entrance to the artificial harbour, but it is not necessary that the breakwater shall be continuous everywhere except at X Y. It may, for more than one reason, be convenient to build it in detachments such as F G X, F G Z, leaving a narrow channel F G between these parts. An advancing wave whose line is—say—roughly parallel to the breakwater will be gradually broken up except at such openings as F G. The spared part of the wave may be supposed to move from some point E along the line E F G. On reaching G it will not continue its course to M with approximately undiminished height of crest. But at G it will start as a new wave radiating from G and travelling to points like N, O, as freely as to M. This new wave rapidly diminishes in strength as it occupies a longer circumference. Thus, even in rough weather, these narrow channels affect only slightly the smoothness of the water inside the harbour. In calm weather they would be useful for the passage of small boats. They would also be convenient for fishermen, and they could, when desired, be closed by nets while the harbour was being dragged.

In the preceding discussion the frictional force of a wave has been neglected. This frictional force on the

Fig. 1

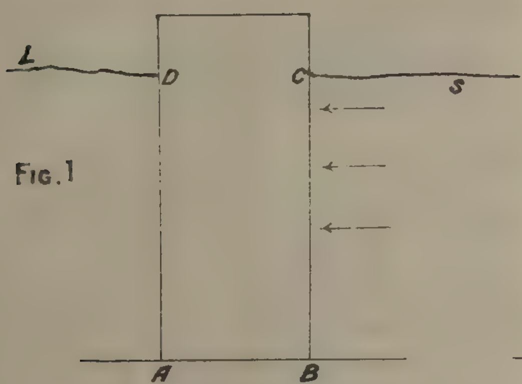


Fig. 2

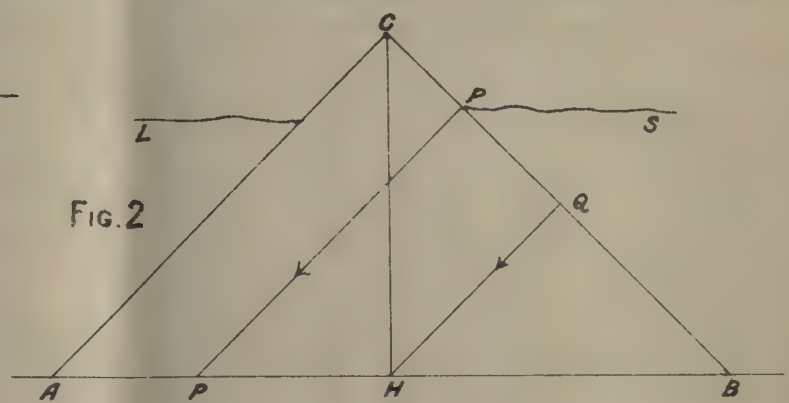


Fig. 3

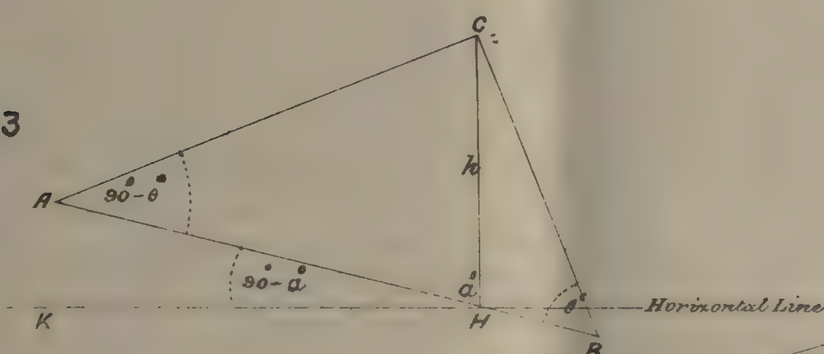


Fig. 4

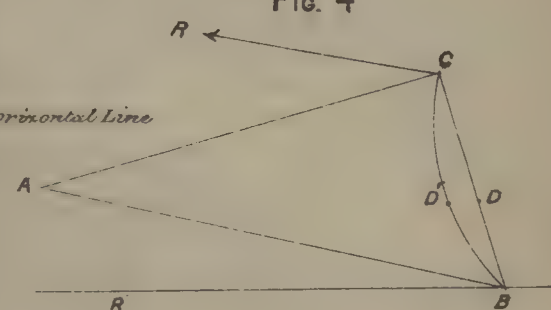


Fig. 5

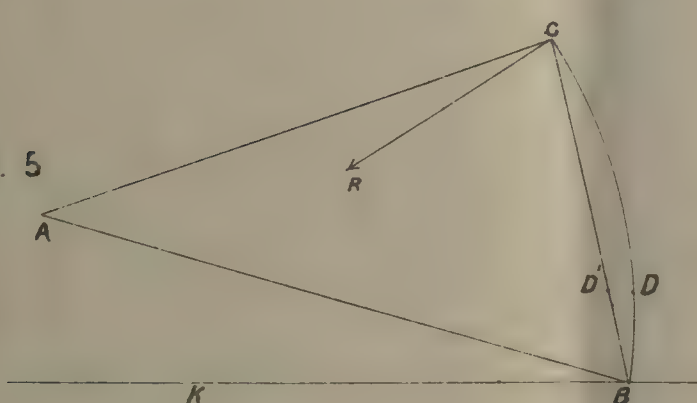


Fig. 6

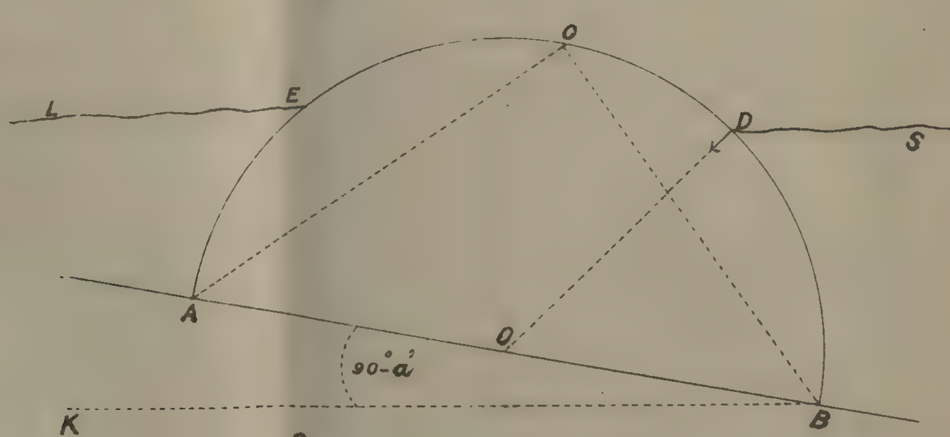
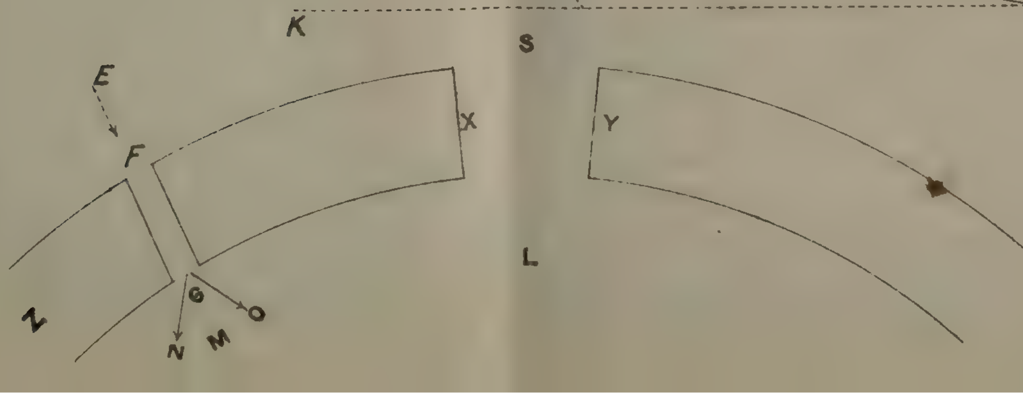


Fig. 7



breakwater depends partly on the want of smoothness in the facing and partly on the sand held in suspension by the water. The frictional force has some tendency to exert a leverage about A. But a much greater and opposite leverage is exerted by the normal components of wave pressures or wave blows. These normal components, with the semicircular facing of fig. 6, pass through O the centre. It is mainly with reference to these frictional or tangential forces that the convex facing is here designed.

A. EWBANK.

REPORT ON THE AURIFEROUS TRACTS, MYSORE.

KOLAR SERIES.

No. I. South Series. This series of the Mysore gold fields commences at the Southern point of the triboundary of Kolar, North Arcot and Salem at a hill known as Mallappakonda in which there is a very large old working upon the Southern point. Again in the ridge of the hill which strikes to the West and forms the southern boundary of Mysore and the Northern boundary of the Krishnagiri Taluk of the Salem District, a drive has been carried into this low range of hills for a considerable distance. From here the gold field takes its Northerly course till it meets the Railway bridge about six miles from the Kamasamudram Railway Station, where the country is rapidly thrown to the West and continues in this Westerly direction for about 2½ miles. Where this throw takes place, the low range of hills which forms the Western boundary of the (now called) Kolar gold fields, commences and continues on to Byatarayanakonda to the North. Here the field again takes an Easterly course being thrown by a granite spur that crosses on to the high range of hills at Mulbagal. This granite spur is to be found at surface from Karpanahalli to Mulbagal. On the East of the Railway bridge, the granite again appears taking a Northerly course East of Yerrakonda and on to Mulbagal, appearing strong close to the tank to the East of Chikmadanagalam, again East of Markoppam, then East of Pichapalli and from thence to Mulbagal. This range of granite to the East and another band of granite about one mile West of the Western range just described, form the East and West boundaries of the No. I or South section of the Kolar Field.

To describe this gold field, it will be necessary to take each of the five series of lodes separately, commencing at the West series. This series is made up of eight reefs with several leaders varying from 6 inches to 2 feet wide, the main lodes being strongly and well defined. Their bearing is about 350° or 10° West of North. This series of lodes can be traced from the Railway to Byatarayanakonda. The ancients have worked them in four places, the first where the road from Kamasamudram passes up a low ghaut to the North-East of Bodgurki, again slightly to the South and on the West of Volagamadikonda, again in the South and North of Volagamadikonda, again slightly to the North-East of the Ajjappalli Bungalow. The Natives here have formed a tank of the old working. The last working on this series is about 1¼ miles due North of Ajjappalli Bungalow and upon a large reef of quartz which appears in outcrop on the crest of a low hill. About 30 chains to the North of this large outcrop, the old workings are to be found. I have tested the debris at all these old workings and found gold in every test I made. I also tested the whole of these reefs from North to South, and found gold in every one of them. My tests were made by washing, as at the time it was doubtful whether gold could be found in paying quantities, and the gentlemen interested in it with me did not feel inclined to incur any expenditure upon the testing of the lodes by trial shafts. Along the run of the whole of these reefs, innumerable mounds of disintegrated quartz are to be found, where the ancients during the rainy season had washed in long troughs made of palmyra trees. As far as I could ascertain from the natives, large quantities of gold had been collected by the ancients in this primitive way. The old workings near the road from Kamasamudram to the gold fields and slightly to the North-East of the village of Bodgurki had been worked more recently than those on other parts of the field also the one to the North of Ajjapalli. These 2 old pits were vigorously worked till the order of General Cubbon (who was then the Commissioner of Mysore) was issued prohibiting all underground work. This order was passed as many men were killed by the falling in of the side walls of the open casts in which they worked. To the South and West of the Railway about one mile from Kamasamudram Station is to be found korundum of the finest quality. The Natives at the present time collect and export this mineral to Madras and Bombay.

The *No. 2 Series of Reefs* lies East of the above described range of hills taking its Southerly point from the Railway about one mile West of the bridge and running North to Karpenhalli. The reefs are six in number. On this series of reefs are the present "Kaisar-i-Hind" and "Nine Reefs" Companies' mines. Commencing from the South the reefs are found in outcrops near the Railway and are easily traced in their course to the North. The great strength of the reefs to the South as far as the South-East boundary of the 'Kaisar"-i-Hind" Company's property prevented the natives from working them. An attempt on their part with their primitive mode of working would be fatal, as on large strong reefs the open casts necessary for removing the quartz would be so great that the head and foot walls would surely fall in, no timber having been used by the ancients. At the South-East corner of the "Kaisar-i-Hind" and in the adjacent block to the East, the "Oriental," also in the "Neutral ground," old workings are found in several places to the North as far as Karpenhalli, the "Nine Reefs" and the greater number of these old workings being upon what I call the "Black reef." I so call it from the quartz being of a very dark color caused by the iron which is to be found in greater abundance in this reef than in any other I know of on the field. Large quantities of gold are to be found all along the run of this reef. The whole of this valley was a favorite place for the washers to resort to during the rains at the time I first visited this gold field. In a watercourse slightly to the South and East of Volagamadikonda was a large alluvial deposit in which the native washers made a drive but did not secure it with timber. The result was that when these people were working in a heading of about 30 feet from where they commenced, the drive collapsed and 4 of the poor creatures were entombed in it. This was about 20 years ago. When I visited this place, the portion of drive dug out to recover the bodies was open and about 15 feet deep. The finest alluvial gold I have seen taken from any part of the South section of the Kolar gold fields was collected from this valley.

(To be continued.)

PRACTICAL NOTES FOR PRACTICAL MEN.

SELECTING FILES.

Remember first quality files—*i.e.*, the best—merely bear the maker's name, the firms' name being ground down after tempering off those files found to be badly cut or badly tempered. Select the heaviest in the box, on account of their being more true than light ones, and better for re-cutting. Take the file to the light, and hold it in a horizontal position, the point of it towards you, you will thus detect any imperfections in the teeth. The teeth should be regular, and the color uniform in a good file. A spotted or mottled file denotes unevenness of temper. In short, if a file present a clean white color, with regular and perfect teeth, and bears the maker's name, you may rely it is a good file.

CLEANING SCREWS FROM RUST.

Rust can be removed from small screws, etc., that are too small for holding against an emery wheel by attrition. Take, say, 1lb. of screws, and place them in a box, a cigar box will do. Put a small quantity of oil on them, and shake for another minute or so, and then sift the saw dust from the screws in a fine sieve, when the screws will be found as good as new.

THE DECAY OF BRICKS.

The weathering of brick walls into a friable state is usually attributed to the action of heat, wet and frost. From observations of M. Parize, the real destroyer is a microscopic creature, and the action played by the weather is only secondary. He has examined the red dust of crumbling bricks, under the microscrope, and found it to consist largely of minute living organisms. A sample of brick dust taken from the heart of a solid brick also showed the same animalculæ but in smaller numbers. The magnifying power of the instrument was 300 diameters. Every decaying brick showed the same kind of population, but the harder the brick the fewer were noticed.

STRAIGHTENING WARPED OR CAST TIMBER.

It is very often found that wood which in the board or plank is perfectly straight or appears to be so, will twist and wind in every conceivable direction, when cut up into long narrow lengths or cross cut into short broad panels. When wood is winding, the only remedy is to plane off the high corners, and make it true by reducing the thickness; but if it be simply cast (one side hollow, and the other round.) the defect may be easily got over. If the man, by working on some other portion of his job, can let the defective pieces stand idle for a day or two, then by placing the wood hollow side down on a plain surface, or by putting two such boards one on the top of the other, with the hollow side facing each other, the wood will draw straight without further trouble. It is always best when possible to work wood in its natural state, as, even if the tendency to cast be overcome previous to working it, there is always the probability of its returning to its normal condition. Some men, when pressed for time, put the round side on the stove. This does indeed make the wood straighter, but there is a great risk of opening and splitting under this treatment, and this liability is very much increased if the wood be at all shaky. If required, the wood can at once be straightened without this risk, by damping the hollow side with water, when the expansion of the fibre on that side pulls it straight.

RIVETTING.

The direct crushing strength of wrought iron is generally about equal to its tensile strength in the case of short isolated bars, but the metal around the rivet hole in a boiler plate is in a different condition, being supported by the surrounding unstrained metal of the plate. Direct experiments which have been made on plates, with the object of ascertaining the crushing strength under these circumstances, show on an average that the crushing resistance may be taken at twice the shearing resistance, consequently, in order that the shearing resistance of the rivet, and the crushing resistance of the plate may be equal, the area of the rivet shank should be equal to twice the product of the thickness of the plate, multiplied by the diameter of the rivet. Deducting from this the value of the diameter of the rivet in terms of the thickness of the plate, we find that it should be $2\frac{1}{2}$ times the thickness of the plate. This is the theoretically correct size of the rivet, but practically it is found necessary to make the rivet somewhat smaller, for the following reasons: First, if the rivet is given the above size, when we reach thicknesses of plate above seven-sixteenths of an inch the rivet becomes too large to be properly closed by hand rivetting. Secondly, the material of the plate is somewhat injured by the punching, and cannot always be relied on to bear the shearing strength. Thirdly, it would be necessary to space the rivets so far apart to retain equal strength of plate and rivet, that it would be impossible to make a steam and water-tight joint. Fourthly, the plate is more apt to be reduced in thickness by corrosion than the diameter of the rivet is, so it is found better to give it an excess of strength at the start to allow for wear. For these reasons the diameter of the rivet is made as small as twice the thickness of the plate, and even smaller for the thicker plates. By placing the rivets in two rows, which is equal to one-half of the pitch, a much tighter and stauncher joint can be obtained than is possible when they are placed in the form of an equilateral triangle as they generally are, which necessitates a reduction of the pitch to obtain a tight joint.

BLOWING OUT BOILERS.

Blowing out boilers should be done at least once a month, except in the very rare instances in which a boiler is used that will not form a scale. The boiler should not be blown out until the furnace is quite cold, as the heat retained in the walls is likely to injure an empty boiler *directly* by overheating the plates, and *indirectly* by hardening the scale within the boiler. Bad effects are likely to follow when a boiler be emptied of its water before the side walls have become cool, but greater injury is likely to result when cold water is pumped into an empty boiler heated in this manner. The unequal contraction of a boiler is likely to produce leaky seams in the shell, and to loosen the tubes and stays. It is a better plan to allow the boiler to remain empty until it is quite cold or sufficiently reduced in temperature to permit its being filled without injury. Many boilers of good material and workmanship have been ruined by the neglect of this simple precaution.

Miscellanea.

TEXTILE AND FACTORY TOPICS.

According to the committees of the New York and Charleston Cotton Exchange, a cotton picker picks at the rate of 180 lbs per hour, or three bales per day.

A new phase of protectionism seems to have crept up in France, authorising the seizure on importation of any goods bearing illicitly a fraduleut indication of their origin.

At the coming Manchester Jubilee Exhibition we may expect to see a good show of the linens of the North of England, the tweeds of the Western Isle, the silks of Dublin, and the laces and needlework of their several country districts.

It is characteristic that the Manchester Chamber of Commerce's resolution that "Having waited in vain more than 40 years, for other nations to follow England's free trade example, this Chamber thinks the time has now arrived to re-consider its decision" was only defeated by a majority of two—21 voting for and 23 voting against.

The master cotton spinners of Bolton and district, representing over 5,0[illegible] spindles and a consumption of more than one-half the entire Egyptian cotton crop, have pointed out the deterioration of Egyptian cotton to the Manchester Chamber of Commerce, praying that this Chamber would use its best influence to arrest the very serious declension in that staple.

A cotton mill managers' union is being mooted for India, but seeing that the practical management of Indian cotton mills is in the hands of a mixture of nationalities with such a wide difference between the capabilities of one manager as compared with those of another, it remains an open question whether such a proposed union could be formed to work well and efficiently.

The depression in the Nottingham lace trade is generally attributed to the continuance in fashion of the foreign embroidered Edelweiss laces, the headquarters of this trade being in Plauen and St. Gall. The embroidery machines for producing these laces are built chiefly in Switzerland, and 88 have been imported into this country from Saxony to compete with the foreign trade. Those manufacturers who did this early have been fairly successful by working with female labour.

On the utility of Consular Reports, the *Textile Manufacturer* thinks the press unanimous in agreeing that the bulk of English Consuls abroad are mere dummies, while consuls of other powers are models of the pattern to which ours should be moulded. This unlimited praise of foreign consuls may stir up ours a little, but it may also make the foreign gentlemen more self-asserting and conceited. There is truth in this, which the proprietor of this paper might equally take to heart!

The increased consumption of raw cotton by Northern and Southern American mills which marked 1885, is also displaying itself in 1886. There are at the present time in the twelve Southern States, twenty mills representing 45,708 spindles and 949 looms idle, but these mills are filled with old machinery, and it would not pay to re-open them. In the twelve States there are 235 mills working with 1,130,249 spindles and 24,672 looms, as compared with 164 mills with 561,360 spindles and 12,399 looms in 1880. In 1880 the consumption of cotton of these twelve States stood at 188,749 bales; in 1885-1886 it stands at 381,066 bales.

Though the actual growing of wool in Japan seems to be improbable, as the only sheep reared there are looked upon as curiosities difficult to bring up, it is said that woollen manufactories will probably be carried on there before long. The Japanese Government and nation see that there is a fair field for starting woollen mills in their country, and if wool could be imported a great industry might be imported. On account of its great firmness, the wool of New Zealand or Australia is the best adapted to Japanese markets, and as Japan has tea, sugar, and rice, all of which are marketable in Australasia, the commercial relations between Japan and those colonies might be developed advantageously by a mutual exchange of produce.

The marking of false lengths upon textile goods shipped to distant markets, such as India, China, Japan, etc, continues. The substance of all these frauds is to defraud the purchaser, and obtain undue advantage over the buyer. The fault lies with the seller, as the manufacturer has nothing to do with the marking of the goods, and possibly it may lie at the door of the buyer who gives all instructions regarding stamping, making-up, and ticketing, etc. Be this as it may, let an Act be passed, rendering it punishable both by fine and imprisonment to do this false or inadequate stamping, just as was done at the time of the cotton famine, when under the temptation of high prices, the poor Hindoo planters mixed their staples, and sometimes added sand to their bales to make them weigh heavier. Many a native planter was sent to gaol under these provisions, but the evil was cured. Where persons committing these commercial frauds could not be reached—such as French, Germans, etc.—confiscation and sale of the goods might prove equally effectual in putting down this abuse.

TECHNICAL AND SCIENTIFIC ITEMS.

The town council at Liskeard have been recommended to light the town by electricity.

The wire mills in America are running full, owing to the extended use of wire for electric purposes and fencing.

Metal is also now being substituted for cardboard, in bookbinding, under the name of the "British Pellisfort" binding.

The Tarnowitzer Iron and Coal Co., who possess some 400,000 tons of slag, propose beginning the manufacture of slag bricks.

The discovery of an immense bed of bituminous coal of excellent quality is reported in the Tehachepi Mountains (California), near the Southern Pacific Railway.

The London and North-Western Railway Co. have despatched an engineer to Drogheda to follow up soundings in connection with the proposed tunnel between Scotland and Ireland.

The Britannia Company are showing at their show rooms (99, Fenchurch Street, London), a new treadle saw, which they state will do work hitherto impossible by hand or by treadle power.

The recent announcement that Messrs. William Cramp and Sons, shipbuilders, of Philadelphia, have contracted to construct a dynamite cruiser for the American Government, marks an important event in marine warfare.

The first problem, in the north-west of Canada, upon the satisfactory solution of which the future prosperity of that territory to a great extent depends, is being rapidly and practically solved by the discovery of coal.

Iron discusses the development of sub-marine warfare and dwells on the change of public opinion visible, in aiding and abetting what a few years back would have been objected to (like explosive bullets) on the score of inhumanity.

The consumption of wire netting has very much increased, and is estimated in Europe to amount to 40,000,000 square yards per annum, in the production of which 420 machines of the old type are used, *viz.*, in Germany, 20; in France, 100; in England, 300.

Electrical Review hopes to chronicle the opening of the central station of the Kensington Court Electric Co., within the next two months, as the work is going on most satisfactorily. This will be the first station on the direct supply system in the metropolis.

Fresh plans for the construction of the Paris Metropolitan Railway have been submitted to the French Chambers. The new project enlarges the original scheme, proposing the construction of five (instead of three) definite lines, and three probable lines instead of one.

Prospectuses are being published by Mr. Samson Barnett, of 4, Westminster Chambers, of a naval and colonial exhibition (to include marine, mining, agricultural, railway, contractors, and other branches of engineering and manufactures) to be held in London from 7th to 24th April next.

Alderman Sir A. B. Walker, who has already provided Liverpool with an art gallery, costing about £50,000, now offers to build an engineering school in connection with the local university college at a cost of £15,000. The gift has been accepted and will be started at once in the college gardens.

Highly developed although the mineral resources of Great Britain be, they are now overtopped by those of the United States; thus in '85 the value of all the minerals and mineral substances produced in Great Britain amounted to £58,000,000, while those of the U. S. A. reached a total of £86,000,000.

In long distance telephony we in this country are far behind the U. S. A., and even the Continent. Over the New York and Boston line, a distance of nearly 300 miles, conversation is carried on with the greatest ease, and even whispers can be distinctly heard between the two towns. At the present time we are content to travel five hours to London and five hours back which a telephonic conversation of only five minutes might render unnecessary. Remarkable go-ahead people we English!

A highly interesting experiment has been had in the lighting of the Glasgow Underground Railway. It is the invention of Mr. Thomas P. Carswell, of the Engineer's Department of the North British Railway. There is a central rail along which the current is sent, raised a little above the level of the permanent rails, while on each of the carriages are contact pulleys, which, coming in contact with this middle rail, convey the current to the incandescent lamps fitted up in the carriages. The experiment was highly successful.

The North-Eastern Railway Co. have determined to test steel sleepers on a more extensive scale, and have given out an order for 20,000, or enough to lay out a length of more than eleven miles. In conjunction with this statement it is interesting to note that Mr. Siemens is continuing his experiments with glass sleepers. Tests conducted at the Anderston Foundry Co., Glasgow, show that these glass sleepers resisted a falling weight of 3¾ cwts. falling upon a rail placed upon the sleeper set in sand ballast, commencing at 6 in. and rising by 6 in. up to 9 ft. 6 in. Cast iron sleepers are expected to withstand a similar test up to 7 ft. only; and the cost of glass sleepers will be considerably less than either iron or steel, while the material is practically imperishable.

The Gazettes.

Bombay, January 6, 1887.

Railways.

The following officers joined their duties at Bombay on the dates noted against each:—Mr. W. H. Parker, Superintending Engineer, 1st class, 2nd January 1887; Mr. E. G. J. McCudden, Executive Engineer, 2nd grade sub *pro. tem.* 11th December 1886; and Mr. H. H. Gahan, Executive Engineer, 3rd grade, 13th December 1886.

N.-W. P. and Oudh, January, 6, 1887.

Irrigation Branch.

Colonel W. Jeffreys, R.E., Superintending Engineer, 1st class, is, on return from furlough, reposted to the charge of the 3rd Circle, Irrigation Works.

Major F. V. Corbett, R.E., Executive Engineer, 1st grade, and Officiating Superintending Engineer, 3rd Circle, is, on relief by Colonel Jeffreys, transferred to the charge of the Betwa Canal.

India. January 8, 1887.

The following promotions are ordered:—

Mr. J. W. Buyers, Superintending Engineer, 3rd class, temporary rank, to Superintending Engineer, 3rd class, sub. *pro tem.*, with effect from 20th May 1886.

Major T. Gracey, R.E., Superintending Engineer, 3rd class, temporary rank, to Superintending Engineer, 3rd class, sub. *pro. tem.* with effect from 5th July 1886.

Mr. C. F. Gilbert, Executive Engineer, 4th grade, sub. *pro tem.*, Rajputana, is transferred to Burmah Provincial Establishment.

Mr. W. H. King, Executive Engineer, 2nd grade, Beluchistan, is appointed to officiate as Superintending Engineer and Joint Secretary to the Agent, Governor-General, Beluchistan, Public Works Department, during the absence on privilege leave of Major A. C. Bigg-Wither, or until further orders.

Military Works Department.

Captain J. C. M. Beresford, R.E., Executive Engineer, 4th grade, is permitted to resign his appointment in the Military Works Department, and is attached to that Department pending further orders.

Central India.

Mr. H. E. Grant, Assistant Engineeer, 2nd grade, held charge of the Office of Executive Engineer, Indore Division, for twelve days, during the absence of Mr. F. M. Scott, Executive Engineer, on privilege leave, from 11th October to 22nd October 1886.

Bengal, January 11, 1887.

Establishment—General.

Mr. C. P. Warde, Assistant Engineer, is transferred, in the interests of the public service, from the Hazaribagh Division to the Office of the Superintending Engineer of the Western Circle.

With reference to Notification No. 452 of the 28th ultimo, Mr. W. A. E. Hanby, Assistant Engineer, is posted to the Hazaribagh Division.

Establishment—Railway.

Mr. R. S. J. Routh, Executive Engineer, 4th grade, temporary rank, Tirhoot State Railway, is granted an extension of one week's privilege leave, in continuation of the 2 months' privilege leave granted him in Notification No. 415, dated 22nd November 1886.

Establishment—Irrigation.

With reference to Notification No. 425 of the 30th November 1886, Mr. J. C. Vertannes, Superintendiug Engineer, class I, is appointed to hold charge of the South-Western Circle.

Mr. A. E. Behrmann, Executive Engineer, 3rd grade, attached to the Circular and Eastern Canals Division, is granted 28 days' privilege leave from such date as he may avail himself of it.

Mr. R. B. Buckley, Officiating Under-Secretary, Irrigation Department, is appointed to be Executive Engineer of the Circular and Eastern Canals Division.

Major A. D. McArthur, R.E., Executive Engineer, 1st grade, on making over charge of the South-Western Circle to Mr. J. C. Vertannes, will revert to his appointment as Under-Secretary, Irrigation Department.

Burmah, January 1, 1887.

Mr H. T. Wadley, Assistant Engineer, 2nd grade, has reported his arrival at Rangoon and his services are placed at the disposal of the Enginear-in-Chief, Burmah State Railway.

Panjab, January 6, 1887.

Irrigation Branch.

Mr. J. J. Mullaly, Executive Engineer, 3rd grade, on return from 7 months' furlough, is posted to the Superintending Engineer's Office, Bari Doab Circle, which he joined on the 17th November 1886.

Mr. J. J. Mullaly, Executive Engineer, 3rd grade, to the Chenab Chanal Division, of which he took over charge on the 22nd November 1886.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

6th January 1887.

111.—George Perfect, of Byraughat, Oudh, Engineer.—*For a radically improved portable sugar cane-crushing machine and parts thereof.*

154.—Charles John Geneste, Managing Director, and Thomas Akitt, Resident Analytical Chemist of the Indigo Company (Limited), both at present residing at Belsand Indigo Factory, Mozufferpore, Tirhoot.—*For improving the quality and increasing the production of indigo from the indigofera by the use of salts of ammonium in the process of manufacture.*

169.—Walter Thompson, Zemindar of Beheea, Shahabad, Bengal, and James Bingham Alliott, Engineer, of Nottingham, England.—*For improvements in centrifugal machines or spinners for draining sugar and other purposes.*

173.—George Washington Miltimore, Manufacturer, residing at Arlington, County of Bennington and State of Vermont, United States of America.—*For improvements in the method of, and machinery for, dressing or dressing and hardening the surfaces of car-wheels and other metal bodies, and in car-wheels having a dressed or dressed and hardened surface.*

226.—Desmond Gerald FitzGerald, of 6, Akermon Road, Brixton, in the County of Surrey, England, Electrician.—*For improvements in the manufacture of plates or elements for voltaic batteries.*

227.—Thomas John Jones, of 11, Queen Victoria Street, in the City of London, England, Electrician, and William Howard Tasker, of 9, Princeton Street, in the County of Middlesex, England, Electrician.—*For improvements in the manufacture of plates or elements for voltaic batteries.*

SELECTED ABSTRACTS OF RECENT INDIAN SPECIFICATIONS.

Producing Lithographic or Zincoghraphic Copies of Photograph or other Designs.—195 (1886).—*Mary Walker and others.* This invention consists of a process for producing copies of photographs or other designs, first, by covering the original with a coating of a certain composition, forming a ground for drawing thereon, and then transferring the coating to stone or zinc or other suitable plate, and printing therefrom lithographically. Second, the preparation and use of this composition, consisting of water, dextrine and starch with kaolin or other equivalent grounding substance to form a coating for a photograph or other design on which the original can be copied. Third, giving special grain or texture to printed copies by impressing the original with its coating on a grained stone or plate.

Improved Apparatus for Scutching and Cleaning Fibrous stems, &c.—131, (1885).—*William Ephraem Death.* A curved shield or guard along which a current of water is made to flow is placed within a short distance of the scutching blades or beaters and concentric with the circle in which they revolve, so that the fibrous stems which extend along this shield being buoyed up by the water current are kept within range of the scutching blades or beaters and are effectually and rapidly operated on by them while the water that is disengaged from the fibres is washed away. This remedies the usual plan of exposing the material to the action of a scutching wheel having blades or beaters. As their action is limited to the small portion of the material which for the time is held up against them by the edge of the table on which it is fed, the operation is thus rendered tedious and imperfect.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Answers to Correspondents.

INVENTOR and R. R. M.—In our next.

SEVERAL Contributions are held over for want of space.

Obituary.

DEATHS.

RUSSELL.—At Shanghai, on the 21st December 1886, Thomas Russell, Manager of the Marine Engineers' Institute, aged 39 years.

MANTELL.—On Christmas Day, at Selangor, Straits Settlements of sunstroke, Hugh McClymont Miller Mantell, Public Works Department, elder son of D. G. Mantell, Survey Department, Ceylon, aged 23.

INDIAN ENGINEERING.

SATURDAY, JANUARY 22, 1887.

PUBLIC WORKS PROGRESS REPORT, PROVINCIAL BRANCH, N.-W. P. AND OUDH, 1885-86.

THE total amount expended during the year was Rs. 56,24,745, *viz* :—

Imperial	Rs. 2,73,543
Provincial	„ 29,68,224
Local	„ 23,48,604
"Contribution"	„ 34,374
Total ...	56,24,745

This includes a charge for establishment of Rs. 11,29,405, and it will be interesting to quote, from former reports, the cost of establishments in recent years.

In 1881-82 establishment cost ...	Rs. 9,71,499
1882-83 „ „ ...	„ 10,15,701
1883-84 „ „ ...	„ 10,58,142
1884-85 „ „ ...	„ 11,06,665
1885-86 „ „ ...	„ 11,29,405

So that, as remarked by the Chief Engineer, there is a steady tendency to increase. Probably, this is due chiefly to the change of system after the constitution of District Boards in 1882-83 (1881-82 being the last year of the "Amalgamation" System), but whether it is to be mainly attributed to excess in the management of purely local works, as the Report would appear to imply, may be doubted; however, the subject has the earnest attention of Government we are told, and we hope that the weak spot may be marked down and strengthened.

The next item of expenditure that we notice is the Thomason Engineering College (Roorkee), which accounts for Rs. 1,66,533, of which the detailed statement tells us that Rs. 1,65,913 is for "establishment," and on turning to the revenue accounts attached to the Report the income is thus stated :—

Rent of buildings	Rs. 4,526
Fees and other receipts from Students ...	„ 3,370
Fines, refunds, and miscellaneous ...	„ 1,45,578
Receipts from printing press and book depot	„ 35,987
Total ...	„ 1,89,461

From the information given it is not possible to form an opinion of much value; for instance, we are nowhere told what "fines, refunds and miscellaneous" means, and as that accounts for more than three-fourths of the revenue, we might have expected a few words as to the items comprised therein. One thing is very clear, that the establishment costs Rs. 1,65,913, while the fees from students only amount to Rs. 3,370. That the College is very popular there is no doubt, and that the education given is cheap is also beyond denial, but whether it is proper for the State to incur such a disproportionate part of the expense is, at any rate, open to question.

The Report notes with satisfaction that the interest taken by *Local* Boards (we suppose *District* Boards are meant) in all matters connected with the communications of their districts have been most marked, both as regards maintenance of existing roads and in constructing new ones to accommodate the increased needs of traffic.

It is remarked that the Boards have practically accepted the normal grant of money, made by Government, as the basis on which the Public Works Administration of the district must be carried on. We may have something more to say on this matter shortly, but in the meantime may state that, as far as our information goes, the districts have had no voice in the matter at all, and that were they consulted, it would be found that the normal grant is not universally approved of.

However this may be, we take this opportunity of reiterating the proposals made by us elsewhere, that *the complete control and execution of works should be exclusively vested in the Public Works Department*. The District Boards should be allowed to initiate local works which they consider necessary, but all such proposals should be supplemented by *special reports* drawn up by the District Engineers on the *necessity* and the *feasibility* of the works recommended by the Boards.

The mismanagement at Agra, in connection with the Artesian Boring, is a typical instance where the advice of experts has been laid aside and the fruit of ignorance gathered with ruinous results to the pockets of the tax payers.

Defects in such and other matters are acknowledged and reforms promised; and we feel sure that the new scheme about to be introduced will be based on wise and safe principles.

INDIAN CIVIL ENGINEERING COLLEGES.

WE have received copy of a memorial to be submitted to Parliament by the Indian alumni of the Engineering Colleges of Calcutta and Seebpore stating the disabilities under which they lie, and how heavily they are handicapped in the race for preferments in the higher departments under Government. They allege that since 1871 not a single native has obtained permanent employment as Engineer, and when the exigencies of the service have led to their employment as such, it has been for a limited period only, and liable to discharge at a month's notice. On the grounds of economy and efficiency, it is said Indian youths are to be preferred to foreigners, because they first serve as Apprentices on Rs. 100 a month, and from the advantages of birth and habit are in every way fitted to endure the climate as well as the hardships and fatigue attending the performance of their duties. The little encouragement given to them has rendered the Indian institutions unpopular, and, in consequence, during the last twelve years only 66 students have passed out of the local engineering colleges, of which only one has attained the rank of Assistant Engineer. The memorialists urge that the concession known among professional men as the "Roorkee Resolution" does not at all improve their position; the average of successful candidates being 5½ per year, the proportion of appointments (1½) allotted to them is too small. In addition to this, it exercises no retrospective effect, and the men who successfully competed before that year are still unprovided for. Exception is also taken to the spirit in which the terms of the P. W. D. Notification No 1146G. of the 23rd August 1883, have been carried out. Although it is ruled that in the case of the appointment of temporary Engineers and Assistant Engineers for the execution of work which could not be undertaken by the ordinary staff of the Department, the claims of the Upper Subordinates who are fitted by experience to conduct the duties required, should be preferred to those of outsiders, it has not been carried out in a single instance. It is, moreover, said that there is a wide divergence between the profession and practice of the Government in the distribution of patronage. The Secretary to the Government of Bengal in his communication, dated the 30th December 1878, addressed to the Superintending Engineer, Presidency, desires it to be known that, as the Public Works Engineering Department is above the authorized strength, there is no prospect of vacancies for the permanent employment of passed students of the Civil Engineering Department of the Presidency College, that they are to consider their status as temporary, and are liable to the contingency of having their services dispensed with whenever, in the public interest, their continued employment may be deemed undesirable. But this block in the service, the memorialists urge, did not prevent a large number of foreigners being provided with employment in that and the following year. Taking the strength of the Assistant Engineers, it is stated there are at present in India on this list 399 men, exclusive of Madras and Bombay, of which 46 are natives, or one native to nearly nine Europeans, and in the next higher grade the proportion is 1 to 30. We reserve our remarks on the memorial for a future issue.

PETROLEUM LAMPS.

THE supplies of petroleum yielded by certain countries, notably America and Russia, are of the greatest possible value to humanity generally. Of the various purposes to which this natural product can be put, the most important so far is that of artificial illumination. Even in towns supplied with gas petroleum is in many cases preferred on the ground of superiority, both as regards cheapness and efficiency. In London, where gas arrangements are of the most perfect description, and where the price thereof is suprisingly low, shops in main thoroughfares may be seen where its use is discarded, and where Petroleum lamps are adopted instead. A large amount of ingenuity has been displayed by inventors, in devising lamps intended to burn mineral oil in such a way as to secure a maximum of efficiency, and safety.

There is one great drawback to the use of petroleum. If a lamp be accidentally overturned or dropped upon the floor in such a way as to spill the contents of the reservoir, and at the same time to set them on fire, the most disastrous consequences may ensue. The petroleum flows in all directions, carrying the flame with it. Water poured upon it will not extinguish it; for being the heavier of the two liquids, it simply serves to float the petroleum, and spread it in all directions. Sand or thick woollen fabrics, such as hearthrugs thrown upon the flames, seem to be the only efficient way of extinguishing them.

Some dreadful disasters—including the recent catastrophe at the Madras Park Fair—have recently occurred from accidents to Petroleum lamps, involving terrible loss, of life and property. These disasters and how best to avoid them for the future may be considered hereafter.

Notes and Comments.

Madras College of Engineering.—Fifteen candidates were found qualified for admission into the Civil and Mechanical Engineer Classes at the competitive examination held in December last; but as there were only ten vacancies, the successful candidates were selected by the order of merit. Of the qualified candidates, 14 are natives—all Brahmins.

Bengal P. W. D. Irrigation Establishment Changes.—Mr. J. C. Vertannes, Superintending Engineer, having completed the work to which he was appointed on special duty, has taken over charge of the South Western Circle, from Major McArthur, R.E. Major McArthur relieves Mr. R. B. Buckley, and returns to the Bengal Secretariat as Under-Secretary, P. W. D. Mr. Buckley has taken over charge of the Circular and Eastern Canals Division from Mr. Behrmann.

The Paumben Canal.—Intending shareholders in this scheme would do well to note the opinion of Governor Grant-Duff expressed in the Minute in which he summed up his five years' experience of the Government of the Madras Presidency:—"Then, there is the much-talked-of Paumben Passage. Well, let any one make it who likes, provided he does not insist upon my being a shareholder. If any combination of millionaires thought fit to do so, they would confer no doubt a trifling benefit upon the town of Madras, provided always they did not care to earn any dividend."

Torpedo Experiments in the Hughli.—As previously announced, a grand torpedo display was carried out on Monday last near Budge-Budge, some twelve miles from Calcutta, under the superintendance of Captain Carter, R.E., and immediate care of Lieutenant Dundee, R.E. The first experiment represented the blowing up of an enemy's vessel by means of a ground mine, the mine containing 1,000 lbs. of gun-cotton being exploded by electricity from the shore. The action of an electro-contact mine was next shown, followed by a variety of minor operations in submarine mining, all of which were eminently successful.

The Acting Port Engineership of Calcutta.—At the last meeting of the Port Commissioners, Mr. Apjohn was elected to act as Engineer to the Commissioners, and Mr. Simmons to the office of Vice-Chairman during Mr. Bruce's absence on furlough. Mr. Apjohn's appointment is a very appropriate one. His large and varied experience in Bengal, on such works as the Chitpore Lock, the Balasore Tidal Canal, and the Midnapore Canal, mark him out as one of the best men that could be chosen for the post, especially in connection with the Kidderpore Dock Works, which will now, we hope, be pushed forward vigorously. Mr. Simmons's appointment also is one that will be generally approved.

New Slip-Dock at Singapore.—The new slip-dock recently inaugurated at Tanjong Rhoo is the only one in Singapore. Elsewhere in the Far East, there is said to be only one at Manila. In the (ordinary) docks pumping and other conveniences interfere with repairing and overhauling vessels. These drawbacks will, of course, be absent from the Tanjong Rhoo slip, which is 450 feet long by 60 broad; vessels up to 600 tons burden can be taken on. The slip-dock thus meets an acknowledged want. It has been under construction for a twelve-month, and is very solidly built. The ways and sleepers are made of *billian* timber from Sandakan, Borneo, which is the best obtainable, and guaranteed to outlast the ironwork of the ways.

The Boomer Press.—This Press, of which Messrs. Burn and Co., Howrah, are the patentees and only makers, was originally of American design, but after great and patient labor it was adapted to the baling of raw materials produced in this country, and the eager way in which it has been taken up by Mofussil growers of fibres shows that it has met a want. The press was originally designed for jute, but is now adapted for other fibres, such as cotton, grass, hay, and hemp. Within the past few months it has been introduced to the Straits for coir fibre and to Madras for cinchona bark, and there are enquiries from Australia for its adaptation to pressing wool. In the carriage of fibres, the presses are said to pay for themselves in about two years, from the saving they effect in the Railway freight, as the waggons carry so much more pressed fibre than they do of loose fibre, to say nothing of the ease of handling and the protection from injury the fibres have in a wrapped up bale.

The Public Works Member of Council.—The question of appointing a successor to Sir Theodore Hope still continues to agitate the Public Works Department. The general desire is that Sir Theodore may be granted an extension, if he thinks fit to apply for one, but failing this issue, three names are generally mentioned as in the running for the appointment. These are Sir C. A. Elliott, the Honourable J. B. Peile, and Colonel W. S. Trevor, R.E. It is quite possible that the last named gentleman may prefer to retire from the service altogether, rather than even take up the duties of the Public Works Member of Council. If this be the case, there can be no doubt that Sir C. A. Elliott is the better man for such a responsible post. He has always, while in Assam, taken great interest in all questions relating to the Department, which he would (if appointed to Council) have to administer, and he is well known to be what is generally termed a "strong man."

The Control of Indian State Railways.—The Committee now sitting for the purpose of considering the reduction or possible abolition of the Director-General of Railways' Office seems to have been chosen somewhat on the *lucus a non lucendo* principle. The members are Colonel Pemberton, R.E., Colonel C. J. Smith, R.E., Major Gracey, R.E., Colonel S. T. Trevor, R.E., and Major-General Hancock, R.E. The last named officer has but a short experience of the work of the office, and the remainder none whatever; for the simple reason that they all, with one exception, have powers of a Director-General in their respective administrations. It is generally understood that the at present enormously heavy work of the office will probably be distributed as much as possible amongst the several Local Governments, and that the appointment of Director-General will sink to the level of an Under Secretaryship for Railways to the Government of India. How far this will commend itself to the officers of the Railway Branch is a very open question, and it seems to us, that if a change is required, the question could be solved in a more popular and efficient manner by entrusting the Managers of the various lines with the powers of a Director-General. Of course we are quite aware that this is what is generally termed a "large order," but if Managers were carefully selected from the best men available, whether Royal Engineers or Civilians, we believe that the scheme would work well. Rather than entrust such large interest to Local Governments, where sometimes the head of the Department has had no Railway experience whatever, things had far better be allowed to remain as they are.

Current News.

Mr. W. A. Billings, Examiner of Public Works Accounts, has retired from the service.

Boring operations for petroleum are to be resumed at Gunda in the Rawal Pindi district.

Colonel J. H. White, RE., Mint Master, Bombay, has resumed charge of his duties from Major A. W. Baird, R.E.

The Maisur Gold Mining Company crushed 716 tons of ore in December last, and obtained 1,007·30 ounces of gold.

The services of Major A. W. Baird, R. E., are replaced at the disposal of the Revenue and Agricultural Department.

Major C. C. Carter, R.E., Inspector of Submarine Mining, has returned to the Presidency from inspection duty at Moulmein and Rangoon.

The ceremony of the consecration of the Lahore Cathedral which is fixed for Tuesday, the 25th instant, will be marked by a public holiday.

Mr. Kipling, of Lahore, has been entrusted with designing the memorial hospital to be erected at Gwalior at a cost of several lakhs of rupees, in memory of the late Maharajah Scindia.

The Maharajah of Bhurtpore is renovating his palace in the historical fortress of Deeg at a cost of over a lakh of rupees. The work is being carried out by Messrs. John and Co. of Agra.

It is understood that no action will be taken in the matter of the disposal of the Ruby Mines until the Government is in possession of the report of Mr. Carter, the civil officer with the Expedition.

Steam tramway is proposed to be constructed between Ongole, the chief town in the sub-division of that name, and the Kottapatam Basin on the Buckingham Canal. Kottapatam is also a sea-port and is distant only 8½ miles from Ongole.

The Secretary of State for India and a party of engineering experts recently paid a visit of inspection to the Sukkur Railway bridge at the Millwall Works near London, and expressed their complete approval of that portion of the bridge erected for experimental purposes.

The Madras Railway authorities have resolved upon constructing another bridge at Chittaravutty, on the North-West Line, between Condapooram and Tadputry. Mr. E. W. Stoney, one of the Company's Engineers, is to have charge of its construction. On the completion of the new bridge, the present one will be pulled down.

The Finance Sub-Committee of the Rangoon Municipality allotted funds in the next Budget for increasing the Engineer's salary by Rs. 100 a month from the 1st March, and for an increment to the Assistant Engineer's pay of Rs. 50 from the 1st March, as personal allowances in recognition of good services rendered to the Municipality.

A sugar manufacturing and refining factory was opened at Nowsaree on the 23rd ultimo. The company to which the factory belongs is on the limited liability system, and the Gaekwar is an extensive shareholder. If this new industry succeeds, it is hoped that the Gaekwar will sanction the establishment of a paper mill, and an oil mill at Gandevi.

The Railway authorities seem sanguine that by the 1st July next they will be issuing Singarini coal. It is to be hoped that this will prove the case, for the sooner the present denudation of forests is put a spot to, the better it would be in the interests of all concerned, not excluding the fuel-supply contractors, who, we hear, are working at a losing rate.

The following Royal Engineers' (late Madras) promotions have been gazetted,—To be Lieutenant-Colonels, *viz.*:—Major Sydenham Cubbon Clarke, *vice* Colonel J. Beatty; Major and Colonel Arthur Frank Hamilton (Commandant, Queen's Own Sappers and Miners), *vice* Colonel J. O. Hasted; Major William Gordon Cumming, *vice* Colonel J. G. Lindsay.

The Superintending Engineers in the Public Works Department in Madras are giving notice to all the temporary establishments, employed under them that their services will not be required after the 1st of March. As, however, the Chief Engineer in Burmah is in want of assistance, all men of good character, and who are willing to serve, will probably find employment in that country.

A portion of the new line known as the Sindh-Sagar State Railway has been opened for traffic from the 1st instant. As soon as the remaining portion is opened, the Examiner's office, will be transferred to Lahore and amalgamated with the office of the Examiner of Accounts, North-Western Railway, at that station. As soon as this amalgamation is effected, some further reductions will be made in the staff of the N.-W. Railway offices.

The statement of receipts and expenses of the Indian Railways from 1st April to 18th December 1886, as published in the last *Gazette of India*, indicates that five Railways show a falling off in their receipts. One is a State line, worked by a guaranteed Company; three are State lines worked by the Government; and one an "assisted" Company's line. The largest decrease, *viz.*, Rs. 5,48,805 and Rs. 37,24,631, occurred on the two important State lines, *viz.*, the East Indian and North-Western respectively.

The cart-road which is to connect Naini Tal with Ranikhet, and so very considerably shorten the distance for heavy transport between that important military station and the plains, is progressing at such a pace as to promise its early completion. The girders for the bridge at Ramgarh, the most serious work remaining to be completed, are already on the spot. The bridge will, it is hoped, be finished by June, and by that time also the remainder of the road will have been cut to within a few miles of Ranikhet.

On the 15th instant the Governor-General of Goa opened the Railway and harbour of Marmagoa for public traffic. There was no official ceremony, but the Municipal Council of the town of Marmagoa gave a banquet in honour of His Excellency and the English officers of the Railway Company. The stations along the line were densely crowded, and great enthusiasm prevailed. The line is opened to the foot of the ghats, a distance of 41 miles. It will be connected by carting with the Southern Mahratta Railway until the heavy ghat works are completed, it is hoped, at the end of the year. The opening of the Southern Mahratta Railway from Dharwar to Castle Rock has not yet been sanctioned.

The question of Railway servants engaging in private practice having been mooted by the Government of India, it has been decided by the Secretary of State, in conjunction with the boards of direction in England of the various guaranteed Railway Companies in India, that officers while in the employ of a company are at liberty to give municipal and other public bodies the benefit of their advice and opinion on technical matters and their engineering experience, provided that such offices are rendered with the consent and permission of the agent of the Railway concerned, and without any remuneration whatever from such public bodies; and so long as they are not actually concerned in the supply of stores, &c., for the work in question.

The Directors of the New Beerbhoom Coal Company have again an excellent report for the shareholders of the working of the concern for the half-year ended 31st October last. The total coal raised was 1,594,120 maunds against 1,597,333 during the previous half-year, while the deliveries were 21,11,442 maunds against 20,85,458, for the previous half-year. The profit made is Rs. 51,-868 against Rs 49,515, a dividend of 5 per cent. is declared, Rs. 7,000 taken to Reserve, and Rs. 5.583 carried forward. The Reserve Fund will now stand at Rs. 80,066 and the wear-and-tear account at Rs. 20,702. For the year ended October 1886 the shareholders will have received a dividend of 10 per cent.; Rs. 13,000 have been taken to Reserve; and Rs. 5,583 carried forward. These results are most satisfactory.

An Austrian, who is at present in Secunderabad, has addressed H. E. the Minister praying for the concession of the exclusive right of navigating the Godavery and its tributaries within limits of these dominions for a term of 51 years. The concessionaire undertakes to build 10 steam-launches, 60 cargo-boats and floats; the last to be used in the reaches where steam-launches and cargo-boats cannot ply. He also asks for permission to cut down teak timber in the adjacent forests by payment of the usual royalty, for the construction of his boats, &c. The concessionaire further undertakes to pay to Government 21 per cent. on the value of all produce and other goods exported by means of his vessels, and 5 per cent. on all imports similarly carried. There are other proposed conditions, but these are the principle.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

THE PROPOSED PATENTS' BILL.

Sir,—It gave me great pleasure to read your comment on the "New Invention and Designs' Bill" in your issue of the 15th instant, and I sincerely hope that your views will induce the Legislative Council to greatly reduce the schedule of fees payable for the protection of inventions. The total amount proposed to be levied is certainly excessively high, nor will the instalments lighten the burden in the least. There can be no reasonable cause or pretext why these fruits of study or brain power should be so unfairly taxed. I say unfairly, because invention is unequally treated to other efforts or results of study or brain power which enjoy perfect immunity from all such imposition. An author, for instance, whether of a scientific work or novel, on payment of a nominal copy right fee of Rs. 2, has full protection for his brain work for life, and his heirs or assignees for 40 years thereafter. Why should we not have the same cheap protection for inventions to which our present great commerce, and even civilization, is altogether indebted? Few local inventors can well meet even the present charge on patents, as shown or proved by the small number registered, about 1 Indian to 8 or 10 of English and foreign inventions filed. I have often desired, and I have heard others express the intention, to take out patents for promising inventions, but these have never been effected or carried out, simply because the fee could not well be spared; thus perhaps much valuable information is often entirely lost. Only very low fees, especially those

payable for the first four or five years, will enable many poor inventors to secure or protect their just rights, the fruits generally of much thought and experiment. It is earnestly hoped that heed will be given to their interest and fair claims.

PATENTEE.

UNFAIR COMPETITION.

SIR,—Everyone must feel for "R. J. I." and his severe case which appeared in your issue of the 1st January. Unfortunately, it is not isolated, and as a fellow sufferer, through the monopoly of all the Engineering appointments in this country by Government, I beg you will grant me space in your columns for this letter. I am one of a number of passed Engineers from an Indian College who have not received an appointment in the D. P. W. and have been thrown on my own resources. I have been twice without work for six and eight months and twice accepted work on a salary that a European Foreman would laugh at. Other Engineers situated like myself have had to be satisfied with appointments as subordinates, or were obliged to leave their profession and take up work to which their education and training is entirely foreign. Government keep a list of unemployed Engineers at their Indian Colleges. Senior men who apply there are kindly told at once that there never is any demand for them, while to junior men the matter often terminates in the offer of a subordinate post in the accounts branch.

Cooper's Hill has been our ruin, and every year only adds to our distress. A great cry has been raised by the Civil Engineers in the D. P. W. against the R. E.s, on the score of injustice. The latter have been holding the higher appointments by seniority, and have made their mark in the Profession in India by their ability, courtesy, and obedience to orders; and any injustice there may have been in their filling the more lucrative appointments is slight compared to that under which we suffer by Government men (mostly C. E.s) filling outside posts; and it is time for us to move in the matter. All those situated as we are to whom I have spoken have expressed themselves willing to join any movement towards having our grievances redressed, and it only remains for some of us to take the initiative, and, forming a committee, bring the matter in the proper form to the notice of the authorities.

B. C. J.

PROVINCIAL PUBLIC WORKS.

SIR,—I observe that you have been favored with an effusion from "H. W. H." on the above subject. If "H. W. H." will peruse the "Administration and Progress Report of the P. W. Department, N.-W. P. and Oudh, 1885-86," I am sure that his troubled spirit will be soothed. In it the Local Boards have been commended for the interest taken by them in Local Public Works and the great good done. Perhaps "H. W. H." has contributed his *mite* towards the attainment of these ends. I would ask him, however, to peruse para. 5 of that report. In it some *slight* modifications of the system of carrying out Provincial and Local Works is contemplated. These sensible ideas have now been embodied in a Resolution No. C. 3175 B. R., dated 24th December 1886, and Colonel Lang's scheme is now going to be tried, as an experiment, in the Rohilkund and Kuman divisions of these Provinces.

The great point advocated by you has been, I am glad to say, *gained*; an Inspecting Engineer (the Ex-Divisional Engineer) has now been appointed to each Commissioner's Division, whose duty will be to inspect and report on Imperial, Provincial, and Local Works entrusted for execution to District Engineers, *appointed from the staff of the Public Works Department*. In my opinion "modestly paid men" as *Engineers* should be avoided, and I would recommend "H. W. H." to peruse para. 2 of the Resolution quoted above. There is no denying the fact that *efficient Professional men* must be *highly paid*. To get at *good results good material* must be employed, and the most judicious plan for the Local Government is to persevere in their efforts to arrive at a comprehensive and economical policy under which all Public Works in this country can be worked with advantage to all parties concerned.

I have no time to go into "H. W. H.'s" figures, but I will venture to remark that it is not practicable to save so large a sum on Rs. 4,53,400 in the N.-W. P. and Oudh by entrusting Public Works, other than Local, to the tender mercies of the District Boards and their "modestly paid" Engineer.

As regards the new scheme alluded to above, I am certain that it will work well, provided that "every man will do his duty" honestly. There is sure to be friction, however, in some cases, but isolated instances affected injuriously by perverse and ill-conditioned individuals need not be seriously considered in the universal adoption of the scheme throughout the N.-W. P. and Oudh.

R.

THE borings in the Delta of the Nile, undertaken by the Royal Society, and entrusted to a detachment of the Royal Engineers by permission of the Secretary of State for War, have now reached a depth of a nearly 200 feet, without the solid bottom having been reached, a depth greater than was generally anticipated. A consignment of specimens has lately arrived in London and is now under examination.

Literary Notices.

TRAUTWINE'S ENGINEERING POCKET BOOK.

THE latest edition of this valuale compilation has now been in the hands of the Profession for some time past, and is unmistakably the most popular publication of its kind extant. It is replete with information that a Civil Engineer requires in practice, besides affording complete but concise knowledge on the *theory* of the subjects dealt with.

The author, the late Mr. J. C. Trautwine, says in his preface that "the book has been prepared for young members of the Profession," but in our humble opinion there is merit and matter enough to place it amongst the ranks of the most favourite works of the same kind. It is superfluous to dwell in any detail on the numerous subjects the book contains. Each subject has been *clearly*, *tersely* and *satisfactorily* elucidated with *thought* and *great pains* by the author who, we regretfully have to mention, is not now labouring amongst us.

The most complicated formulæ have been in numerous instances reduced to the simplest forms possible. One citation will be sufficient. Turning to page 525 "Strength of materials" we find this formula :—

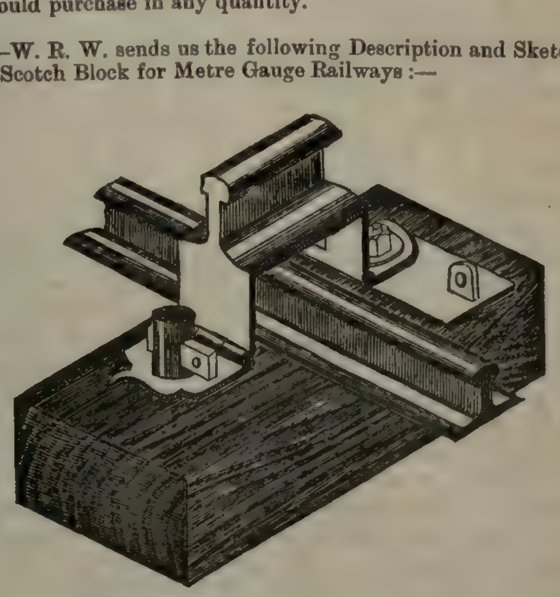
$$\left.\begin{array}{l}\text{Ultimate Cen-}\\\text{tre Load in lbs.}\end{array}\right\} = \frac{2800 \times \begin{array}{c}\text{Area of Cross section.}\\\text{in inches.}\end{array} \times \begin{array}{c}\text{Depth of beam.}\\\text{in inches.}\end{array}}{\text{Clear span in feet.}}$$

which gives most economical and reliable results for T and L iron. The old formulæ for obtaining the transverse strength of these sections of iron involve so tedious an operation that Trautwine's new formulæ, approximate though they may be, will be eagerly accepted in practice by the most fastidious of our brethren in the Profession. More matter has been added by Mr. J. C. Trautwine, Jr., and we sincerely congratulate him as the possessor of an inheritance so valuable.

Notes and Queries.

(1.)—JUMBO writes :—I would feel obliged if any one of your readers would inform me of the uses of asbestos, and whether there is a demand for the article, and the name of a firm that would purchase in any quantity.

(2.)—W. R. W. sends us the following Description and Sketch of a Rail Scotch Block for Metre Gauge Railways :—



The Scotch Block is made with the ordinary M. G. rails, 41¼ lbs. to the yard, and for lightness the width has been reduced to the thickness of the head of the rail. It is 6" long. It is so fitted that when closed on to the line 3½ inches will be inside the gauge and 2½ outside. It is held down to the line sleeper by a bolt and nut, which also allows of it being turned to be dropped under the sleeper, outside the gauge. It is inside the gauge locked when on the line by means of a key with a lock hole which passes through a slit in the bolt. It is hinged in and outside the gauge, to enable it to drop under the sleeper when locked off the line. It is necessary for a pit to be built with a wooden cover to keep the arrangement free from ballast.

General Articles.

RANGOON DRAINAGE PROJECT.

Shone's Hydro-Pneumatic System.

(Continued from last issue.)

The outfall sewer proceeds from Station No. 1 under and along Dalhousie Street until China Street is reached; it will then proceed southward along China Street to Merchant Street, whence it will proceed eastwards till the point A is reached on the line of that street, and from the latter point it will proceed to the outlet in the river along the course approved of for Mr. Clark's outfall sewer. Our outfall sewer being common to all the Ejectors, its size increases as the quantity of sewage ejected into it increases, and as this takes place for the most part at each Ejector Station it becomes telescopic-like in form. It is smallest between Stations Nos. 1 and 2 and largest after the connections from the Ejectors in Station No. 22 are joined up to it. The Ejectors in Nos. 1, 2, 3, 6, and 7 Stations will discharge into the main laid under Dalhousie and China Streets, and Ejectors Nos. 4, 5, and 8 will discharge into a branch outfall sewer under the Strand; this latter will join the Dalhousie and China Streets sewer at the junction of the Strand Road and Merchant Street. The main outfall sewer will then run along Merchant Street, taking up the sewage of the Stations Nos. 9, 14, 15, 20, and 21, as well as the sewage which will be ejected into it from Stations Nos. 10, 13, 16, and 19, situate in Dalhousie Street. The sewage from the Stations Nos. 11, 12, 17, 18, and 22, which are in Fraser Street, will be received by a branch outfall sewer which will join the main outfall sewer in Judah Ezekiel Street at the point where that Street forms a junction with Merchant Street. That you may comprehend how our project is worked out and what provision is made for increase in the population, we have made out the accompanying tabulated statement of details, which will doubtless be thoroughly understood and appreciated.

Our proposals for the drainage of both the night-soil and sulliage waters will be readily understood by a reference to Drawing No. 2. The red lines in the centre of the drainage spaces represent iron gravitating sewers, on which five junctions for the drainage of the sulliage and night-soil will be cast. The sulliage waters will be discharged at or thrown upon a cast-iron plate (see figs. 1 and 2 on Drawing No. 2) to be fixed between two plots of building land. The waters discharged on them will flow by gravitation; firstly, into the five-inch gravitating iron pipe; and secondly, into the seven-inch gravitating iron pipe, whence it will proceed to the Ejectors to the Ejector Station. In the middle of each back drainage space will be erected a night-soil depôt (see Drawing No. 2) for the reception and passage of the night-soil into the seven-inch iron gravitating sewer.

The shape, form, and size of the night-soil depôt are shown on Drawing No. 4. At the heads of the seven-inch gravitating sewers, Shone's Automatic Flush Tanks will be erected. These are designed to be capable of charging the gravitating sewer quickly and for a considerable distance, so as to secure an intermittent self-cleansing scour of the entire system of gravitating sewers daily. The size and form of these will be shown on Drawing No. 5.

Having regard to the nature of the soil under Rangoon, and the desirability of keeping the Pneumatic Ejector Stations water-tight, we propose to construct them in iron tubing, and oval in shape. Drawing No. 3 shows the form of the Ejectors and the Ejector Stations which we propose to adopt. The Ejectors are in duplicate at each station, so that they can be worked separately or conjointly, and each will be capable of ejecting the whole of the sewage due from the area draining into each Ejector Station. In case of accident to one of the Ejectors, therefore, the other may be employed singly to do the whole work.

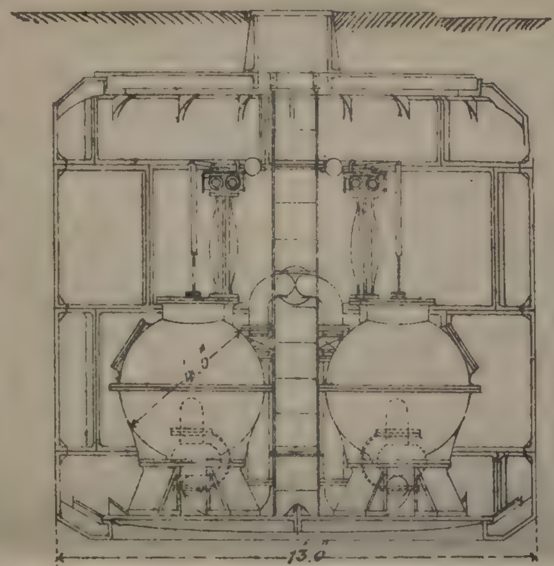
It will be seen that the sewage before entering the Pneumatic Station passes through a man-hole, at which, if the station is under a spot where four streets meet, four separate gravitating seven-inch sewers converge, after arriving at this man-hole, the sewage is turned into the inlet pipe of the Pneumatic Ejectors. Each Ejector holds 200 gallons of sewage. They are intermittent in their action. If they are filled in a minute, they will be emptied in a minute. But if they cannot be filled for want of sewage, say in ten minutes or ten hours, they will not go off; they will only go off—that is, discharge their contents—when they are full. As already stated, they are emptied by compressed air, which must be supplied to them in volumes corresponding to the volumes of sewage to be ejected at each station. The compressed air is supplied to them through small air-pipes. These air-pipes proceed from the air-compressing station, and for the sake of shortening their length as much as possible, the engineer lays them under the streets which give the least distance between the air-compressing station, and the various Pneumatic Ejector Stations to be reached by them. The air-main is largest where it first emerges from the compressing station, and it is smallest when it reaches, for instance, No. 1 Ejector Station; but none of the air-pipes are less than three inches in diameter. The mode of distributing the compressed air is very similar to the mode adopted in distributing coal gas for lighting purposes. The gas-main is largest where the largest quantity of gas passes through it, but as branch after branch proceeds from it, each carrying its quota out of the sum total of gas supplied, the gas-main diminishes in size until it is at its smallest; so it is with the compressed air-mains. Compressed air thus becomes a convenient as well as a harmless and clean power for distribution in a town.

TABULATED DETAILS OF SCHEME.

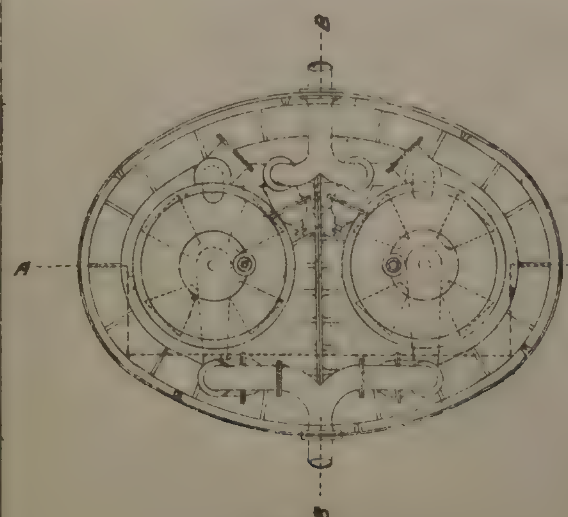
Number of Ejector Stations.	Gallons per Minute.	Diameter of Main.	Length in Yards.	Inlet Level of Gravitating Sewer.	Discharge Level of Ejector.	Ground Level of Ejector Station.	Lift to 111·00 H.W.M.	Head due to Friction.	Dynamical Head.	Length of Gravitating Mains. Yards.	Number of Flush Tanks.	Present Estimate of Population.	Population provided for at 30 gallons per head per day.
1	93	5"	325	103	99	111	12	50	62	1,800	2	2,056	2,480
2	116	7"	320	104	100	111	11	46	57	2,450	2	2,741	3,093
3	93	8"	320	105	101	112	10	43	53	1,800	2	2,056	2,480
4	70	5"	320	104	101	111	11	38	49	1,350	2	1,572	1,866
5	77	6"	320	104	101	112	10	34	44	1,800	2	1,713	2,053
6	77	9"	320	105	101	112	10	39	49	1,800	2	1,712	2,053
7	77	10"	460	110	106	113	5	36	41	1,800	2	1,713	2,053
8	77	7"	170	105	101	112	10	32	42	1,800	2	1,712	2,053
9	108	14"	320	106	102	112	9	31	40	1,800	2	2,398	2,880
10	92	5"	310	111	107	115	4	34	38	1,800	2	2,100	2,453
11	20	5"	320	112	108	119	3	39	42	420	—	313	533
12	92	5"	360	111	107	119	4	39	43	1,800	2	2,000	2,453
13	92	5"	310	110	106	115	5	32	37	1,800	2	2,200	2,880
14	108	15"	360	106	102	114	9	29	38	2,250	2	2,398	2,880
15	20	15"	320	108	104	117	7	26	33	1,050	—	350	533
16	47	5"	310	109	105	117	6	30	36	2,700	3	918	1,253
17	30	6"	320	109	105	119	6	33	39	1,800	2	612	800
18	60	8"	320	105	101	118	10	30	40	3,600	4	1,224	1,600
19	35	5"	310	112	108	119	3	26	29	1,800	2	727	933
20	32	16"	320	114	110	120	1	24	25	1,800	2	727	853
21	70	16"	170	112	108	117	3	23	26	3,600	4	1,454	1,866
22	60	9"	790	105	101	115	10	27	37	3,600	4	1,224	1,600
	1,546									44,420	47	33,920	41,648

(To be continued.)

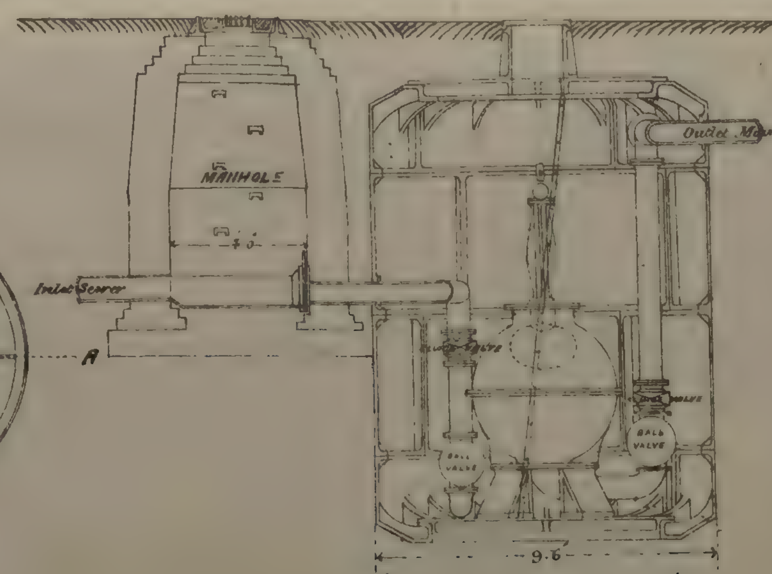
PLATE. IV



Section A A.



Plan



Section B B.

PROJECT FOR THE SEWERAGE

AND

SUPPLEMENTARY HIGH PRESSURE WATER SUPPLY

FOR

CITY OF RANGOON,

ON THE

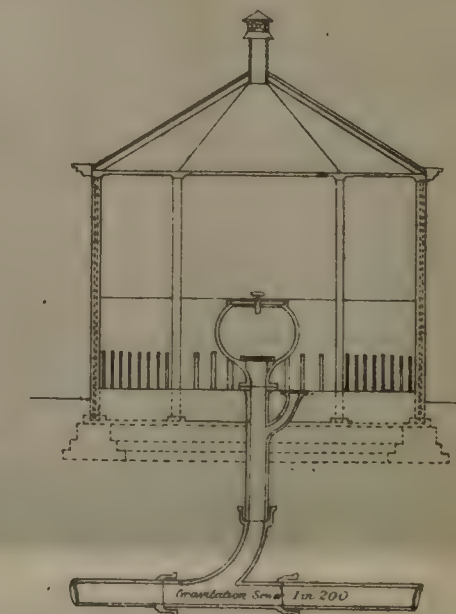
SHONE HYDRO-PNEUMATIC SYSTEM

SCALE : $\frac{1}{8}$ INCH TO A FOOT

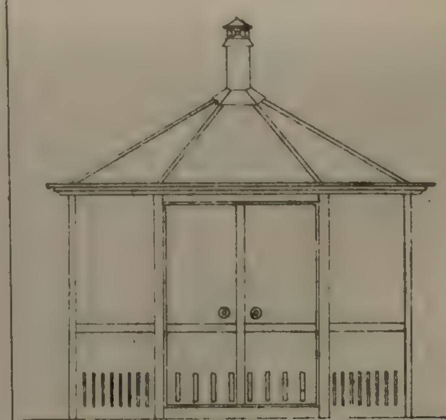
SHONE AND AULT,
Westminster, London ;

O. DEACON CLARK,
Rangoon, Burmah

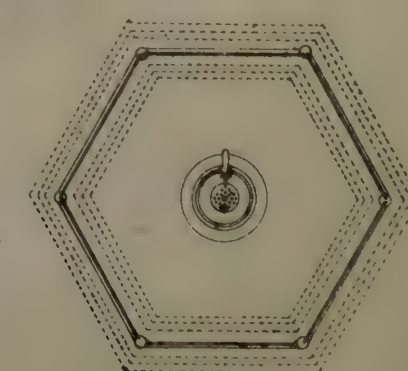
PLATE. III



Cross Section.



Elevation.



Plan.

CEYLON RAILWAYS.

The Blackwater Slip.

(Expressly for Indian Engineering.)

On the 20th August 1886, the heavy rains that had previously been falling for some time produced a very heavy slip on the Nanu-Oya Railway extension on Blackwater Tea Estate.

The slip occurred at a double cutting on sidelong ground on the high side, which is calculated to be 150 feet high, and displaced about 150,000 cubic yards of *dêbris* consisting of mostly stone, or semi-decomposed stone. The ground over which our mountain railways are constructed is abrupt, broken and sidelong, and puts one in mind of the place which the Irishman describes as the spoil banks of the Creator during the world's creation.

This necessitates heavy cuttings, steep gradients, and sharp curves. The formation is generally gneissic or quartzy, the dip of the strata varying greatly. It also contains much felspar, which on exposure to the atmosphere after being cut through, weathers and decomposes rapidly.

The climate is everywhere moist in the up-country parts of Ceylon, but Ambagamuwa, where this slip has occurred, is more than ordinarily so, the rainfall being about 200 inches annually on the average.

Nature of Debris.

At Hermatgoda the curiously weatherd cliff-like hills are composed of a stone the colour and consistency of red granite, and so onward to the cliff supported terraces of Allagala, but on passing Galbodde cliffs and the Hogg's back pierced by two tunnels, we come across hills and knolls composed of hard, barren sheet rock, alternating with or overlying gneiss formations of the softest, loosest, and most treacherous character. Hence, after a downpour of 6 to 15 inches in 24 hours, there is not much wonder if sometimes whole knolls disappear—particularly when the slipperishness of the rain saturated mica is taken into account.

Through a formation such as this was this 80-foot cutting excavated in deference to the contractor, a tunnel having been first decided on, and the result was this the greatest collapse that the staff have ever had to clear up.

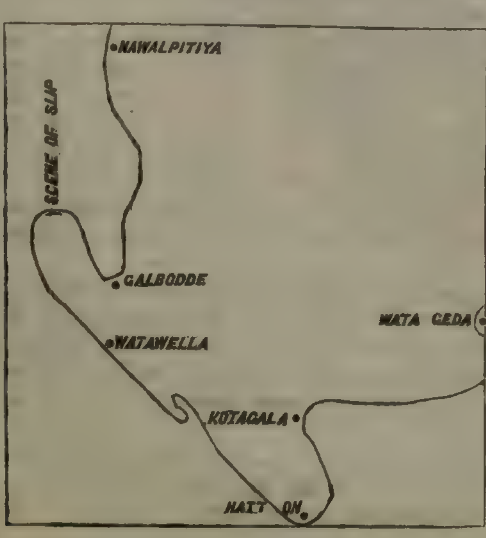
The cutting was literally choked up with *dêbris* of clays of all colours, mingled with soil and masses of rock.

The cutting is shown in the diagram below to be situated on a curve of 6·37 chains on an incline of 1 in 44, not far from the centre of the 5¾ mile loop between Galbodde and Watawella stations, which are only a full mile distant from one another as the crow flies.

The actual dimensions of the slip itself was 8 chains by 3, or, say, an area of 2 acres. The contents of clearage is approximately estimated at 150,000 cubic yards.

The scene of the slip is 97½ miles from Colombo and 9¾ from Nawalapitiya, 2¾ miles above Galbodde.

The nature of the ground and difficulties of construction may be gathered when we say that in 20 miles and 68 chains between Nawalapitiya and Hatton the ruling gradient of 1 in 44 prevails over 17m. 78ch., there being a stretch of 5m. 73ch. with nothing easier. Six miles 76·95ch. only out of the whole is straight. Nearly 14miles are on curves of various radii, some being as sharp as 5ch, and 6·37 prevails over 79 curves of 5m. 34ch. in length.



Work of clearing away.

On the Ceylon Railway there is nothing in the way of tools for such purposes as above more complicated than the mamotie, and small cooly baskets, and as under such circumstances a large force would be required, and no accommodation existed, the first thing necessary, therefore, was to build lines. This was first given out on contract, but then a difficulty arose in procuring hands to work in this, to them cold, wet region. Various men came forward with schemes and suggestions, one offering to clear it by November for Rs. 40,000; Mr. Spooner, of the P. W. D., the Governor's pet, of painted bath fame, suggested the Californian or Australian monitor, which he named his Hydromatic monitor; the P. W. Department, which estimated considerably more than Rs. 1,60,000 for the job; and for this latter sum the Railway staff undertook to do it. Eventually, the Governor decided that the Railway staff should commence work and clear away until Mr. Spooner constructed his monitor. As soon as the earth was removed, the true composition began to reveal itself in the shape of rocks of all sizes from five tons downward with large chinks between, so that a large blast of dynamite, which was tried, blew out, and the Resident Engineer had to give orders for all stone to be drilled and blasted into workable pieces. These were finally trundled down an inclined plane made up of rails placed with their heads alternately up and down.

Since the construction of the dam for Mr. Spooner's monitor, the smaller rubbish has been washed down to some extent by a stream of water led therefrom, but this was only partly successful, as the water every now and again lost itself with crevasses.

Traffic Arrangements.

From one cause and another, there was great difficulty experienced in shifting the goods from the Galbodde to the Watawella side of the slip, various individuals contracting for same, but ultimately failing at the same time the staff were not idle in endeavouring to overcome the difficulty, which lay, not in the distance, which is only a quarter of a mile as the crow flies, but in the treacherousness of the ground, which forbade either a cart or tram road being cut. Here the Governor, Sir Arthur Gordon, stepped in and procured at once a wire tram which was lying idle at Mr. Edward's store. This has been erected and works fairly satisfactorily, although attention has to be assiduously paid to it, as the carriers are continually leaving the wires, due to vibration when the wires are slack. The joints seem a difficulty they are unable to overcome.

The line being continuous, both stations at Galbodde and Watawella are loading and unloading on either side of the staging, the wire being set in motion at Watawella by a 12 H.-P. horizontal high pressure engine, and communicated to the upright shaft by means of belting and directly on to the shaft's wheel by a worm (which gives a strain of 12 tons on the shaft). This shaft supports the sheave that sets the wire in motion. At each station there is a staging with rail on top whereon the goods are loaded, and at Galbodde there is the straining apparatus—the carrier being provided with an Indian-rubber bearing surface and a sheave at the side to catch the guide rail of the loading and unloading staging.

Timber posts are erected 40 feet apart, carrying a double cantilever which supports the sheaves on which the wires run. All timber is green, being cut from the jungle on the spot.

On loading at Galbodde you travel up the wire at a gradient of 25 degrees to the top of the hill and then down to Watawella.

Greatest load on one carrier has been 4 cwt.

Frank W. Thomson, B.E.,
M. I. C. E. I.

The Russian papers last received contain the news that the railway from Merv to Charjui on the Oxus was completed on the 13th of December. The first train arrived at Charjui on that day with the celebrations customary on such occasions. Generals Annenkoff and Komaroff, and about 200 Russian officers and officials of the Amir of Bokhara, are said to have been present at the ceremony. It may be noted that the railway is of very narrow gauge, and hardly deserves to be described as more than a tramway. It is not always prudent to depreciate the resources of a possible enemy; but there can be no question that the line cannot compare for solidity with the Hurnai or even the Bolan Railway.

LOWERING AN IRON GIRDER BRIDGE.

The sketch annexed (No. 1), is a view of an iron girder bridge on one of the main metalled roads in the N.-W. Provinces. It was considered expedient to lower the formation of the roadway to a point 8 feet below that originally designed and constructed.

2. The bridge consists of three bays of 60 feet each. The longitudinal main girders are 65 feet long each and 5 feet deep of wrought iron plates rivetted and of I shape. These are placed at 12′ centres. The cross girders are rivetted plate girder of I shape 12″ deep and laid 3′ centres. These girders are overlaid with buckled plating ¼″ thick, and 9″ of metalling forms the roadway.

3. Sketch No. 2 represents the cross section of the bridge, showing the arrangements for lowering. The entire iron superstructure of the three spans was lowered bodily without any portion of it being taken to pieces. The kunkur metalling was taken off before the lowering operations were commenced.

4. The total weight of the iron work was 60 tons. One span weighed approximately 20 tons, and the half span 10 tons.

5. The lowering arrangements as shown consisted of two salwood blocks 12″×7″×12,″ *a*, *a* in plan. These were supported in position by a salwood beam *b*, 12″×8,″ placed across. This beam was kept in position by four screw jacks, each capable of lifting 3 tons. Between the beam and jack head were placed salwood blocks 9″×9″×9,″*c*, *c*, and each pair of jacks stood on salwood planks 3″ thick, *e*, resting on a cushion of 1″ of sand.

6. The sketch shows the arrangement on an abutment. On the other abutment and piers the arrangements were exactly the same, but on the piers each screw jack was capable of lifting 5 tons, and the beam was flitched with iron.

7. When the arrangements were complete, and the screw jacks fixed in position, four able-bodied men were allotted to each jack. Over each abutment and pier stood an overseer to control the working. As a preliminary measure the gangs were drilled for a few hours in screwing and unscrewing *simultaneously*. When the Engineer in charge was satisfied with the discipline of the workmen, the lowering operations were carried out in the following manner.

No. 1 *bell*—Gangs got into position. *No.* 2 *bell*—Each man applied his hand to the levers fixed into the capstan heads of jacks. *No.* 3 *bell*—Every man began to *screw up simultaneously*, and as soon as the lower flanges of the girders were 1″ above masonry, *No.* 4 *bell was struck*, and gangs left off screwing, took to chisel and hammer and dismantled the brickwork for a depth of 3″ as shown in plan at *d*. When this was completed on all the abutments and piers, *No. 5 bell was struck*, men left off dismantling and got into position. *No.* 6 *bell*—Hands were applied to levers, and No. 7 *bell* directed the gangs to *unscrew* until the main girders again rested on the abutments. These operations were repeated until the iron superstructure was placed 8 feet below original level. The lowering operations took 9 days only.

R.

NOTES OF AN EXPERIMENT MADE IN MADRAS WITH RANSOME'S SILICATE AND CALCIUM.

The experiment was made on the new southern wing of the P. W. D. offices. This section of the building is 23 feet long and 49 feet broad. It was commenced in February and completed in July 1884, and was built entirely of stock bricks in shell lime mortar and painted with stone lime.

2. The stock bricks were made at the Government manufactory, where a Hoffman's kiln is used. All the bricks are three inches thick, which is twice the thickness of the ordinary Madras brick, but the special advantage in the use of Hoffman's Kilns is, that it imparts the heat so gradually and steadily, that the centre of a good brick is as well burnt as the surface. The stock bricks, however, receive no mechanical pressure, but the clay is carefully prepared and thrown into the moulds with some force.

3. After completion of the building, the scaffolding was not removed, but about ten days allowed for complete drying before applying the silicate. The middle of the hottest part of the day was chosen as the most suitable for the using of the silicate—July and August are generally the driest months in Madras, so that in this respect all the necessary precautions were taken to make the experiment a fair one.

4. Immediately before applying the silicate, the surface of the wall was well cleaned, everything like dust, lime marks, &c., was removed with *dry* brushes and cocoanut fibre scrubbers. The silicate was then applied from the top, first, second, and third coats, with an interval of about 20 minutes between each. After the third coat, a glistening surface was shown on some portions of the brick-work, and there no more silicate was used. Where this was not shown, a fourth and fifth coating was given. In no place was more than five coats necessary to leave a glistening surface, showing that sufficient silicate had been absorbed. As this was intended as an experiment, in two small patches a sixth and seventh coating was applied, and in other places only one and two coats, and in one section no silicate whatever was used.

5. The silicate was applied with a full brush, but not allowed to drip. The brush was passed very slowly and steadily from left to right on the surface of the wall, so that the bricks were not starved, but allowed their full drink of the solution with each coating of the silicate.

6. The prepared calcium was applied similarly to the silicate, and two or three days after the latter. In places where a sixth and seventh coating of silicate was used a dull greyish film was observed on surface of the wall after application of the calcium, evidently the silicate of lime. In other parts there was no perceptible change on the surface. Precautions were taken not to use the same vessels or brushes for the calcium as were used for the silicate.

7. Two monsoons have now passed over the buildings since using the silicate. Particular note was made of the effects of the heavy rains and general dampness that pervades during the monsoons on the silicated walls; it was found that dampness was shown as much on the inner surface of the silicated portions of the building as in the parts that were not silicated. If this dampness is due to the absorption of rain water on the exposed outside surface of the walls and not to the moisture floating about in the air inside the rooms, then it must be concluded that the silicate did not destroy the porosity of the bricks, and is no preventative to the dampness caused by the absorption of rain water. During the monsoon months, however, the air both inside and outside a building is so heavily charged with moisture that the dampness observed on the inner surface of the walls may not have been due to the absorption of rain water on the outside. Rain in the dry months showed no dampness on the inside of the building, but left a moisture on the exposed outside.

8. The best buildings in Madras are erected on the sea face. The ozone and salt in the fresh sea air have a most injurious effect in corroding the brickwork and rusting the iron, &c. The building on which this silicate experiment had been tried is also on the sea face, and is fully exposed to all the injurious effects of the sea air, but though two years have now passed no sign whatever is shown of crumbling away in the surface of any of the bricks.

9. As good brickwork weathers, a hard veneer is gradually formed on the surface of the bricks, and this helps to preserve them for a very considerable time. The silicated walls have been carefully watched to see if the silicate helps in any such process. As yet nothing is perceptible.

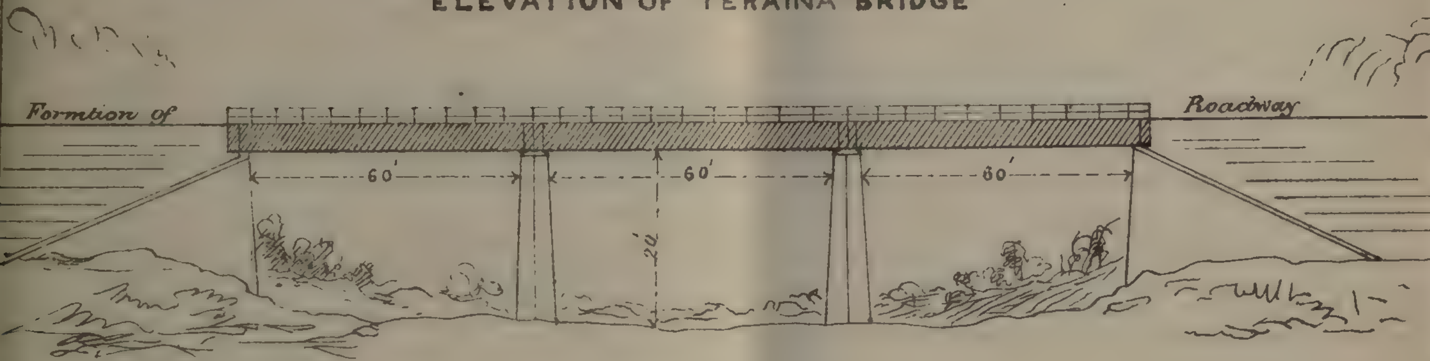
The silicate costs a little over Rs. 3 per square of wall surface, but this would be cheap if it has all the good effects the patentees ascribe to it.

J. H. S.

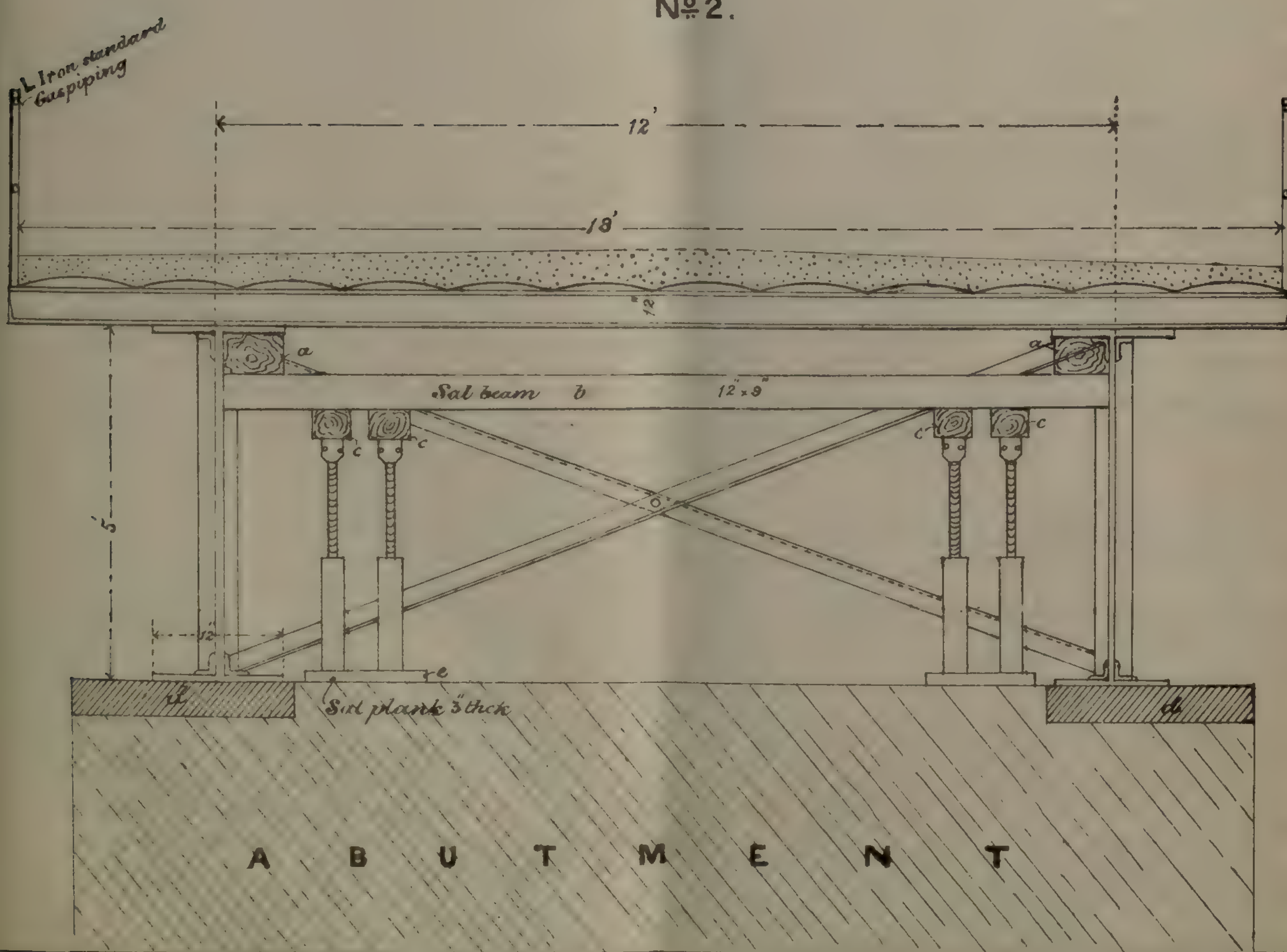
LOWERING AN IRON GIRDER BRIDGE.

Nº 1

ELEVATION OF TERAINA BRIDGE



Nº 2.



The "STAR" Press, 19, Lall Bazaar Street, Calcutta

HARD WOODS.

(Translated from *Le Monde de la Science et de l'Industrie* For INDIAN ENGINEERING.)

THE term *Hard Woods* refers to those woods in which the grain is closer, the texture firmer, the force of resistance to horizontal and vertical pressure greater, and finally the thickness above 0·600.

To this group belong the oak, ash, elm, chestnut, birch, walnut, plane, and sycamore.

The elm is much affected by peculiarities of soil, and can only thrive in rich fertile lands, which are too valuable for large spaces to be sacrificed to the cultivation of trees.

The chestnut, used for carpentering, is very similar to the oak, but inferior in quality.

The shade cast by the birch tree is fatal to all plants growing in it: when the branches have grown to a certain thickness, they cannot be lopped off, or pruned without destroying the tree. The wood is not nearly as strong as that of the oak, and is more liable to be attacked by worms.

The walnut requires plenty of space and a good depth of earth.

The ash grows to a good height in rich soil only: its wood is, like that of the birch, very often destroyed by worms.

The plane and sycamore trees are very beautiful and of rapid growth: their wood, however, is only of medium strength and quality.

It will be seen, therefore, that none of these trees, on account of their respective properties, can, for many essential reasons, be compared to, or take the place of, the oak.

We have in France, only one tree in no way inferior to, and in many points surpassing, the oak—

1st.—By its rapid growth.

2ndly.—By its power of enduring intense cold, which greatly injures the oak.

3rdly.—By the qualities of its wood, which is sounder, heavier, stronger, almost without alburnum, less affected by worms and moisture, less likely to shrink from desiccation, of a finer, closer grain and a better colour.

This is the *Robinia*, false Acacia, commonly known in France under the generic name of "Acacia." It has been cultivated in Europe for the last 300 years only.

The varieties, the excellent qualities, of, and the different purposes for which the oak is used, are too well known to detain us long. However little we need say of the common oak, there is one variety of this valuable article which merits special mention.

The OAK CORK is the most important of the forest trees of Algeria; the plantations of this tree cover a space of over 500,000 hectares, that is, one-fourth of the entire wooded surface of the Colony. The thickest plantations of this valuable wood, those of La Calle and Bôner, are found near the coast, their situation itself facilitating the exportation of the cork, of which the annual production amounts to 300,000 kilogrammes, worth about 4,000,000 francs. These returns are still somewhat small, but will increase considerably when the natives of the country learn the value of the timber and the most advantageous way of utilising it. The wood will, on the other hand, fetch a higher price when roads and railways extend throughout French Africa and facilitate the transport of timber. Up to the present time, manufacturing and private companies alone have worked the forests of oak-cork. The State at first granted them the privilege of planting, and afterwards allowed them sole possession on condition of a small indemnity payable at a long date. The Government does not scruple to set aside for this purpose nearly 50,000 hectares of ground, the more valuable as the land covered by these plantations is usually granitic and hilly. If such lands were not sheltered, the rock, instead of softening from the effects of shade and humidity, would remain hard and refractory to any future use to be made of it. Although the oaks are planted very far apart (150 trees to the hectare only are found in forests of about 100 years growth), it must not be imagined that the earth is entirely bare of vegetation. It is covered with a thick undergrowth of shrubs, mingled with the foliage of a thousand varieties of African flora. This undergrowth has to be destroyed in order to get at the trunks of the trees, in spring, at the time of the cork harvest. At this season, there takes place in plantations of not less than twenty-five years growth, the process of unmasking, that is, the peeling off of the outer bark, which would otherwise fall off itself at the end of a certain number of years, if not artificially removed.

The flaws and other defects to be found in hard woods are numerous, and are usually caused by cold.

The oak is frequently found to have split in the direction of its height, and the cleft which is at once seen gaping widely increases in proportion as the temperature falls. This is called a frost crack. When warm weather comes water gathers in the opening and there very often results a rotting of the wood. Sometimes the trunk of a felled oak seems to be formed of two concentric cylinders, one hollow and other solid, the latter exactly fitting into the former. The wood is then said to be "rolled." While the presence of a frost crack betrays itself by the round swelling which is invariably found closing up the opening, a "rolling" is never visible, and like most hidden defects, is on that account, so much the more serious. Very often water penetrates into this internal cleft and causes the wood to rot away. The branches of the tree die off one after the other, and its life, which at the beginning was propagated from the core to the periphery, extinguished from the periphery to the core. What is the cause of the "rolling?" In this, as in every other instance when causes are in question, no two opinions agree; but it is almost a certainty that frost is one of the causes of this serious defect, which is frequently found in oaks after they are cut down.

An opponent of this opinion wrote somewhere: "If frost produces 'rolling,' all trees of the same age, in the same forest and subject to the same influences, should prove to be 'rolled' in the same way." As if it were possible, in the animal as well as in the vegetable world, to find two individuals identical in every point. And yet it is an indispensable condition that identical influences produce the same effect.

However this may be, after certain exceptionally cold winters, for instance, the winters of 1709, 1749, 1789 and 1829, there were seen in horizontal sections made from the trunks of certain oaks, patches of varying shades of colour. Reddish or brownish, sometimes dark, sometimes light, their colour usually blends into that of the surrounding wood. At times the patch is spongy and saturated with very dark, almost black sap; it also exhales a fetid odour, but very often there is no outward sign of corruption. If the portion of wood in which this is found is used for any purpose, the hidden flaw is at once perceived. It goes by the name of a moon-mark. And why? No doubt from the former, and very erroneous belief that the moon exercised a fatal influence on vegetation. By excessive cold, the white wood which envelopes the heart, or core of the oak, and which goes by the name of alburnum, becomes completely or partially congealed. At the end of some years the wood becomes useless for every purpose. Not only is it impossible to use it for buildings, but the blocks of wood cannot even be cut up in order to utilise them in other ways. They very soon become worm eaten, and if employed in the manufacture of casks, greatly injure the qualities of liquids contained in them. Wine in such casks could not be preserved for any length of time.

In spite of being invisible, moon-marks and "rollings" are none the less very serious blemishes, and timber merchants would do well to beware of them.

A. A.

THE Hong-Kong Brick and Cement Manufacturing Co. were to have started operations last month. They have called up $30,000 out of a capital of $100,000

THE Ceylon Government propose, we learn, to accept the plans of the War Office for the defences of Colombo. The estimated cost is £34,000, which is to be spread over two years.

A FRENCH engineer has obtained a concession for the construction of a railway from Teheran to Shabdulazm, a distance of four miles. The capital for the undertaking is chiefly Russian.

AN agreement has been concluded between the Suez Canal Company and the Egyptian Government, whereby the width of the Canal from Port Said to the Bitter Lakes is to be increased to forty-four metres and thence to Suez to sixty-five metres.

A REPORT has been circulated in Tientsin, with considerable definiteness, that the French have been entrusted with the construction of a railway from Tientsin to Cheng-chia-wan, a distance of 50 Chinese li. This result is said to be the immediate result of the trials of the Decauville Tramway.

IT has been decided to take steps to close the Hong-Kong and Macao Glass Manufacturing at once, the work being carried on at a loss.

NOTE ON THE MODE OF BURNING LIME NOW FOLLOWED AT LAHORE.

By Rai Bahadur Kunhyalall, M. Inst. C. E.

In former times kunker lime burnt with oopla in open kilns was used on works. Even the Mahomedan architects and builders used this sort of lime largely on their works, which stand up to this day as monuments of strength and durability.

An inspection of these old Mahomedan buildings shows that *unscreened* lime was then used; the mortar forming a sort of concrete made of unburnt pieces of kunker and the burnt lime.

This mortar is now as hard as *stone*, and cannot be cut or broken, except with iron picks, and other sharp tools.

But there is one great defect in this kind of lime, which is, that the ashes of oopla with which the lime is burnt cannot be thoroughly separated from the lime. Large lumps of burnt oopla can be removed, but a *large* quantity of it crumbles away *inside* the kiln, and is *mixed* with the lime, from which it is utterly impossible to separate it.

To remedy this defect, the lime is now burnt with *charcoal* fuel in *close* kilns. A small quantity of this fuel burns a large quantity of lime, and its ashes are *very trifling* compared with the quantity of lime burnt.

Small kilns sufficient to burn 100 cubic feet of lime only were used first; but the demand for this sort of lime having increased, large kilns which burn about 1,000 to 1,200 cubic feet of kunker, are now used.

Plate I. shows the small kiln, and Plate II the large kiln. The lime and charcoal are, sometimes, mixed together, and loaded in the kiln, and burnt. But the *best* plan is to put in the kunker and fuel in regular layers as shown in the plans. A layer of about 9 inches of broken oopla is given at the bottom, then, a layer of $1\frac{1}{4}$ inches of charcoal, and above that, a layer of 4 inches of *clean* kunker, and so on, till the top of the kiln is reached, above which the layers of charcoal fuel are increased to 2 inches in thickness. The top of the kiln is finished like a segment of a sphere, with 2 layers of oopla on top, and then the kiln is fired. In the small kiln, the thickness of the layers of fuel and kunker is regulated by measuring every layer as it is put in; but in the large kilns, a rod of wood is used, on which the thickness of the layers is marked in black and white, black for the fuel, and white for the kunker. This rod is put in the middle of the kiln as shown in Plate II., and is withdrawn when the kiln is loaded and ready to be fired from the hole at the bottom.

The kiln takes about 7 or 8 days to burn, 3 or 4 days to cool, and a day to unload. In the hot weather, lime is obtained out of the kiln in about 12 days, and in the cold weather it takes 15 days.

Sometimes, when charcoal is scarce or dear, wood fuel is used in the same way as charcoal, but the thickness of the layers of wood varies from 3 to 6 inches according to the size of the pieces of wood used.

The following is the proportion of fuel used in burning the lime:—

Kind of fuel used.	*Quantity required per 100 c. feet of Kunker.*
Oopla in open kiln (old Method)	60 to 70 mds.
Wood Keekur, ...	20 mds.
„ Jund ...	25 „
Charcoal Keekur,	10 „
„ Jund ...	$12\frac{1}{2}$ „

When a kiln is unloaded, the ashes of oopla are first removed from the top, then the burnt lime is taken out and slaked with as much water thrown over it as will turn it into powder. Whilst the water is being thrown over the burnt pieces of kunker, they give a sound like that in parching gram, and emit considerable heat. In this state the lime is slightly beaten with long thick rods of any jungle wood, collected into a heap, and left alone for a few hours, after which the heap is opened, and lime of an almost white color comes out of the heap.

The color of the lime depends much on the quality of the kunker used. If *pure swept kunker* is used, the lime is almost of a white color, but if inferior kunker containing earth and dirt is used, the lime is of a dull white or reddish color. Oopla fuel also gives lime of a reddish color. The *best* lime is obtained from kunker *entirely free* from earth and other impurities, and with keekur charcoal used as fuel. With wood fuel the lime changes its color to a dull white. The inside of the kiln should also be kept clean and plastered smooth after its having been used 3 or 4 times. This is necessary to prevent earth from the sides of the kiln mixing and burning with the lime.

The plans are on a large scale and explain themselves, and thus there is no need of describing them.

Lahore, 1*st December* 1886. K. L.

PRACTICAL NOTES FOR PRACTICAL MEN.

GLASS DRILLING.

For drilling holes in glass a common steel drill, well made and well tempered, is the best tool. The steel should be forged at a low temperature so as to be sure not to burn it and then tempered as hard as possible in a bath of salt water that has been well boiled. Such a drill will go through glass very rapidly if kept well moistened with turpentine in which some camphor has been dissolved. Dilute sulphuric acid is equally good if not better. In Berlin glass castings for pump-barrels, &c., are drilled, planed, aud bored, like iron ones, and in the same lathes and machines by the aid of sulphuric acid. A little practice with these different plans will enable the operator to cut and work glass as easily as brass or iron.

TO ENGINE TENDERS.

Examine the piston packing in the cylinder frequently, for the purpose of seeing that it is in good order. In cases of extreme heating slack up on the keys and gibs, permit them to run loose for a time, and then take up the lost motion gradually. Keep the cylinder and steam pipes well covered with some good non-conductor to counteract the action of the atmosphere. Whenever a clicking noise is heard in the cylinder open the cylinder drain cocks, and allow the water to escape. Then let them remain open until the cylinder works dry steam. Before starting an engine always warm up the cylinders by admitting the steam to both ends. Whenever an engine is stopped for any length of time examine all its parts for the purpose of seeing if they are in good order.

VENEER MAKING.

Straight grained and moderately soft woods are sliced off a log by a weighted knife with a drawing cut, the log or burl being 10 feet long and the veneers varying from an $\frac{1}{8}$th in. to 1-40th in., the width corresponding, of course, to the diameter of the log. A knife machine which gives a half-rotary movement to a semi-cylindrical turned log, allowing a veneer to be cut following the log's diameter, produces wide veneers from logs of small diameters. But while the knife has opened up new possibilities in veneer manufacture, the saw has by no means been abandoned. Such woods as ebony and lignum vitæ cannot be cut with a knife, while finely figured and consequently close-grained mahogany and some rosewood is difficult to cut. The saw, therefore, has its place. Such saws must be very thin, and so firmly adjusted that hardly the slightest variation will occur in the thickness of the veneers turned out. Whilst a nicely arranged circular saw will turn out boards varying the one-twentieth part of an inch, which would be imperceptible, such a lack of uniformity in thin sheets would prove a damaging imperfection. Before being cut the veneer material must be carefully steamed, the same as in bending. A tight box, 12 feet long and 4 feet deep and 4 feet wide, is used, and exhaust steam is utilised. An ordinary wood like black walnut, which has an open grain, will steam sufficiently in six hours, but the close-grained South American woods require thirty-six hours. Mahogany will steam sufficiently in twenty four hours. Mahogany, tulip and rosewood being hard to cut, require more and careful steaming and a knife in the best condition. The veneers wrinkle when laid together, but straighten out readily when glued properly to a body. Veneers will dry in the air in about twelve hours but are not kiln dry, although the latter method is used for lumber out of which veneers are to be made.

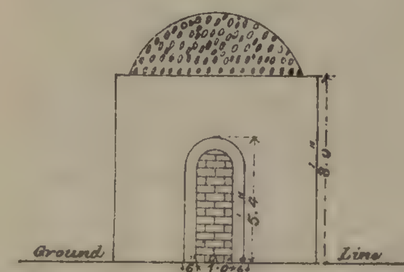
PLATE I.

SMALL CLOSE KILN,

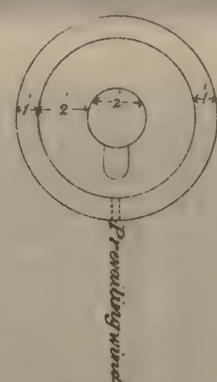
In use at Lahore,

For burning Kunker lime with charocal.

SCALE : 8 ft. to an inch.



Elevation



References :—

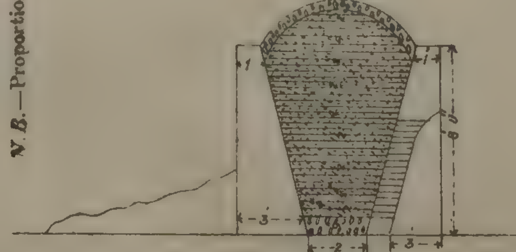
Kunker Charcoal

Oopla

Kutcha Masonry

Dry brickwork grating in door

N. B.—Proportion of Material : 8 c.ft. kunker to 33 seers charcoal.



Cross Section

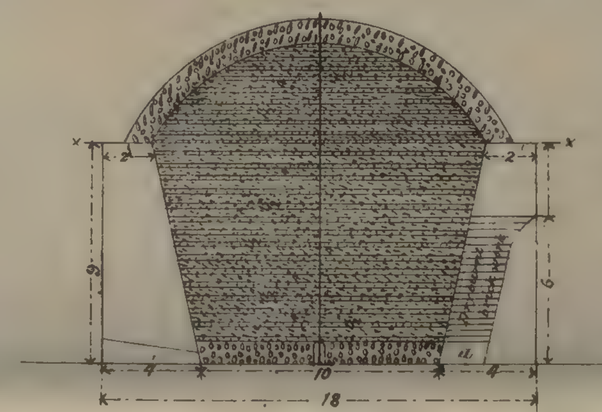
LAHORE : 1st December 1886.

PLATE II.

LARGE KILN,

In use at Lahore,

For burning Kunker Lime.

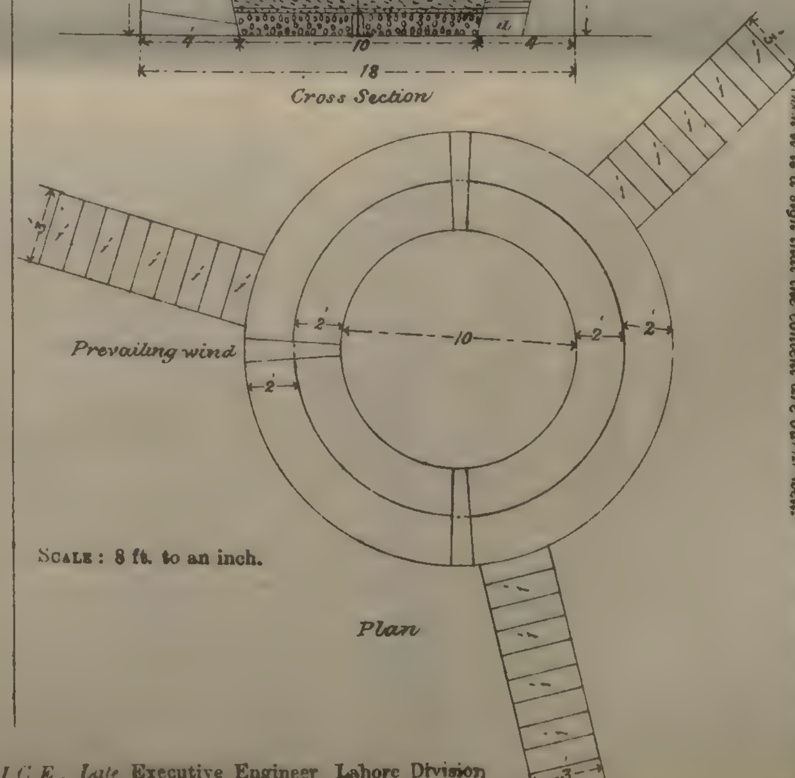


Cross Section

NOTE.—*Up to this height each layer of* keekur *charcoal is* 1½ *hick, and, above this, 2" thick. The layers of kunker are all 4" thick.*

When the kiln is ready to be unloaded, the dry burnt brickwork is removed, and the lime taken out.

The kiln is fired from the hole a

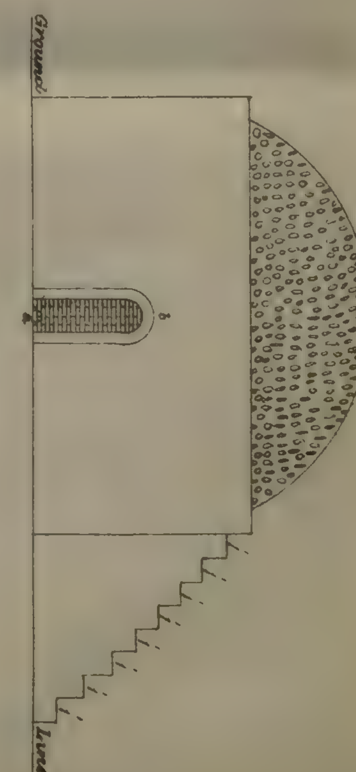


SCALE : 8 ft. to an inch.

Plan

NOTE. *When the kiln is to be loaded, the opening* a b *is closed with dry brickwork of burnt bricks, and plastered on the outside, leaving the hole* a *open. When the top of the kiln sinks to the level of the walls, then it is a sign that the content are burnt well.*

Elevation



Kanhya Lall, M.I.C.E., *Late* Executive Engineer, Lahore Division

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, January 15, 1887.

Mr. W. J. Greer, Executive Engineer, 4th grade, sub. *pro. tem.* North-Western Provinces and Oudh, temporarily employed in the Punjab, is permanently transferred to the Punjab.

Mr. A. T. Chiodetti, Assistant Engineer, 2nd grade, State Railways, is transferred temporarily from the Establishment under the Director-General of Railways to that under the Government of Bombay for employment on the Godra-Rutlam Railway Survey.

Mr. G. Mills, Assistant Engineer, 1st grade, State Railways, is transferred temporarily from the Establishment under the Government of Bengal to that under the Director-General of Railways.

The Governor-General in Council is pleased to order the following promotions and reversions to, and in the classes of Chief and Superintending Engineers, with effect from the dates specified :—

Mr. H. F. White, Superintending Engineer, 2nd class, temporary rank to be Superintending Engineer, 3rd class, temporary rank, with effect from 20th October 1886.

Major T. C. Manderson, R.E., Superintending Engineer, 2nd class, to be Superintending Engineer, 1st class, temporary rank, with effect from 1st November 1886.

Mr. H. F. White, Superintending Engineer, 3rd class,[temporary rank to be Superintending Engineer, 2nd class temporary with effect from 1st November, 1886.

Major T. C. Manderson R.E., Superintending Engineer, 1st class to be Superintending Engineer, 2nd class with effect from 25th November 1886.

Mr. H. F. White, Superintending Engineer, 2nd class, to be Superintending Engineer, 3rd class, temporary rank with effect from 25th November, 1886.

Colonel C. M. Browne, R.E., Chief Engineer, 3rd class, Special, to be Chief Engineer, 2nd class, permanent, with effect from 26th November, 1886.

Railways.

Lieutenant O. M. Thackwell, R.E., Assistant Engineer, 1st grade, is transferred, in the interests of the public service, from the Sind-Pishin State Railway to the North-Western Railway.

Captain G. K. Scott-Moncrieff, R.E., Executive Engineer, 4th grade, temporary rank, is, on return from furlough, posted to the Toungoo-Mandalay Extension of the Burmah State Railway.

Mr. J. Tait, Executive Engineer, 3rd grade, is, in the interests of the public service, transferred from the Sind-Sagar State Railway to the Office of the Director-General of Railways.

Mr. G. T. St. A. Nixon, Assistant Engineer, 1st grade, is, on return from furlough, posted to Toungoo-Mandalay Extension of Burmah State Railway.

Bombay, January 13, 1887.

Railways.

Colonel K. A. Jopp, R.E., Deputy Consulting Engineer for Railways and Under-Secretary to Government, P.W.D. (Railway), is granted special leave on urgent private affairs out of India for six months from such date as he may be able to avail himself of it.

Burma, January 8, 1887.

Mr. E. J. Rumsby, Executive Engineer, 3rd grade, sub. *pro. tem.*, is transfered from the Ningyan division to the charge of the Mandalay division.

Mr. E. J. Rumsby, Executive Engineer, 3rd grade, made over, and Mr. J. F. Hewitt, temporary Upper Subordinate, received, charge of the Ningyan division on the afternoon of the 17th December 1886.

Mr. J. C. Rees, Executive Engineer, 3rd grade, temporarily attached to the Burmah State Railway, is re-transferred to the Provincial Establishment and appointed to the charge of the Ningyan division.

With reference to *Burmah Gazette.* Notification No. 3, dated the 7th January 1887, Mr. J. F. Hewitt, temporary Upper Subordinate, made over, and Mr. J. C. Rees, Executive Engineer, 3rd grade, received, charge of the Ningyan division on the forenoon of the 29th December 1886.

Railways—Extension.

Mr. H. T. Wadley, Assistant Engineer, 2nd grade, is posted to the 7th or Kyauksè division, Toungoo-Mandalay (State) Railway.

Madras, January 11, 1887.

The following intimation, received from the Secretary of State, is published :—

Mr. J. W. Rundall, Superintending Engineer, 2nd class, permitted to return within period of leave.

Mr. H. E. G. Evans, Executive Engineer, 4th Grade, sub. *pro. tem,* permitted to return within period of leave.

The following promotion is made :—

M. R. Ry. S. A. Subrahmanya Aiyar Avargal, B.A., B.C.E., Rai Sahib, Assistant Engineer, 3rd Grade, to be Assistant Engineer, 2nd Grade, from 10th December, 1886.—Permanent.

M. R. Ry. S. A. Subrahmanya Aiyar Avargal, B.A., B.C.E., Rai Sahib, Assistant Enginee, 3rd grade, is declared to have passed, on the 10th December 1886, the professional examination prescribed in paragraph 87 of the Public Works Department Code.

With the sanction of the Government of India, the title of "Rai Bahadur" is conferred *ex-officio* on the undermentioned officer :—

M. R. Ry. S. Gopala Krishna Aiyar Avargal, B.C.E., Rai Sahib, Assistant Engineer, 1st grade.

N.-W. P. and Oudh, January 15, 1887.

Irrigation Branch.

Mr. G. E. Coles, Executive Engineer, 3rd grade has been granted by Her Majesty's Secretary of State for India six months' extraordinary leave on medical certificate without pay, in extension of the leave notified in this Department Notification No. 2190 E.I., dated the 21st August 1886.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

13th January 1887.

137 of 1886.—Nur Ahmed, son of Ilahi Baksh, caste Tarkhán, inhabitant of Montgomery, in the Punjab.—*For the grinding of wheat and other grains for the purpose of reducing the same to flour.*

191 of 1886.—Evaristo Conrado Engelberg, Mechanical Engineer, of Piracicaba, Province San Paulo, Empire of Brazil.—*For improvements in rice-hulling machines.*

207 of 1886.—William Bull, Civil Engineer, at present residing in Bombay.—*For improvements in the manufacture of tubular tiles.*

1 of 1887.—Marcel Deprez and Bruno Abdank-Abakanowicz, both of 11 Boulevard Magenta, Paris, France, Electrical Engineers.—*For improvements in apparatus for transmitting and receiving electrical signals.*

SELECTED ABSTRACTS OF RECENT INDIAN SPECIFICATIONS.

An improved and more economical method in the Formation of Brick Kilns and of Burning Brick.—162 (1886). *Henry Bull.* The invention relates to an improved and economical method in the formation of Trench Brick Kilns as follows, and it consists, first, of building up the kiln on a flooring of burnt bricks laid flat up broken or half bricks laid in flues so as to interpose a cushion of air between the kiln and the damp ground. The second part of this invention relates to the stacking of the kiln on a new plan of breaking the parallel walls usually set up by vertical furnaces, five or six inches in width, and in these narrow breaks bricks are set in such a way as to catch and distribute the coal.

Improvements in Miniature Ammunition and for adapting Fire arms for its use.—193 (1885).—*Richard Morris.* It is found of great advantage to practise sighting, aiming and drill with firearms, using miniature ammunition so as to avoid the necessity for long ranges and the expense of ammunition of ordinary size. According to this invention the breech tubes are constructed to receive the miniature cartridges, so that they are made suitable for drill operations, precisely corresponding with the regular service drill of the arm. The breech is bored with a hole large enough to admit the screw end of the small bore tube, so that it enters for some distance without screwing, there being a screw thread only in the lower part or rear end of the hole in the breech. When the tube introduced from the muzzle it is screwed into the breech piece, the junction where the end piece abuts upon the internal shoulder of the breech piece being very near the base of the latter. The miniature cartridge is made with a solid metal base of such depth as to cover the junction and thus avoid the difficulty which attends the extraction of spent cartridge shells when they are such that the thin metal of the shell is forced by the explosion into the unction.

A. Method of desiccating air for Drying purposes.—139 (1885).—*George Greig.* In many cases when a current of air is passed through chambers or apparatus for drying purposes, the air is so charged with moisture that it is ineffective for drying, or even sometimes instead of drying it moistens the objects over which it passes. This invention relates to a method of desiccating more or less the current of air employed for drying by absorbing from it a portion of the moisture dissolved or suspended in it, before it enters the drying chamber or apparatus. For this purpose the air current is caused to pass through a sheet or through several successive sheets, or porous fabric, which is itself kept dry and capable of absorbing moisture in the following manner. The fabric, forming a continuous web passing round or over rollers, is caused to travel across the air passage so as to present a continuously changing portion of its length, through which the air has to pass. Some of the rollers round or over which the fabric passes are heated by steam or otherwise, so that the fabric somewhat moistened by the passage of moist air through it, is so far heated in passing over these rollers, that the moisture held in it is more or less evaporated. Others of the rollers are kept cool, so that the fabric, after having been heated as above described, is cooled again before it passes to the air channel and is thus rendered again susceptible of absorbing moisture. The rollers last mentioned may be kept cool in the following manner. Each of these rollers is made with a metallic periphery within which is a tube of porous material so much smaller than the interior of the roller, that there is an annular space kept charged with water which oozing through the porous tube keeps its inner surface moist—a current of air being caused to pass through the tube the moisture on its surface is evaporated, and considerable cold is thus produced keeping the roller cool. The fabric may be impregnated with substances absorbent of moisture. Instead of passing the air through the fabric, it may be caused to pass in thin layers between travelling sheets of the fabric, or it may be projected against or reflected from a web travelling in front of an impervious screen.

Extracts.

LAHORE SCHOOL OF ART.

We are happy to find that Sir Lepel Griffin is in accord with us about the professional merits of Mr. J. Lockwood Kipling, whom he has determined to entrust with the designing of the Memorial Hospital about to be erected at Gwalior to the memory of the late Maharajah Sindhia. The cost of the work will certainly amount to several lakhs of rupees, and will afford the Lahore School of Art, which did so well with the design for the Aitchison College an opportunity of showing what more they can do in applying Eastern architectural resources to Western requirements. Should Sir Lepel Griffin only remain in Central India long enough to start the various public buildings at Gwalior which are likely to signalize the minority of its future Chief, there is every hope that no fresh addition will be made to the large list of such buildings springing from the regulation source, which help to discredit the artistic perceptions of the English race.

MADRAS HARBOUR WORKS—1886.

The progress of the Madras Harbour Works was not so great as was hoped for when the year commenced, but what was done was done well. The submerged foundations of rubble were well advanced and 230 feet of the new wall of the North, and 172 feet of similar work at the South pier were finished. Great lengths of the portions which withstood the storm of November 1881 were protected by blocks of concrete, weighing 30 tons each, dropped in outside the two walls. For this purpose 1,517 blocks were used, representing about 37,925 tons of concrete. In May a cyclone visited Madras, and was attended by a heavy sea. The only way in which this affected the works was by overturning about 70 feet of the old damaged wall at the South pier, and rolling the blocks on to the top of the foundations of the new work. The ruined walls had stood from November 1881 to May 1886 without alteration, but since then many "islands" have been more or less displaced. Another cyclone last November tried what little was built of the new work with good results. No damage was sustained beyond the usual tearing up of the rails.

Notices.

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Mr. E. A. DUKES, late Manager of Messrs. W. Newman & Co., Ld., Calcutta, is now representing INDIAN ENGINEERING in the Upper Provinces.

Owing to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Answers to Correspondents.

Several Contributions are held over for want of space.

INDIAN ENGINEERING.

SATURDAY, JANUARY 29, 1887.

THE INDIAN CIVIL ENGINEERING COLLEGES.

Last week we gave a short *resumé* of the memorial to Parliament of the alumni of the Indian Engineering Colleges in Calcutta and Shibpore. On the face of it, the memorialists have made out a plausible case, but those who have gone beyond skin-deep into the matter will hardly congratulate them either on the line of argument adopted or the conclusions arrived at. They take exception to the recruitment of the service by Cooper's Hill graduates, ignoring the fact that the latter have had rare opportunities which their Indian brethren have not enjoyed, *viz.*, profiting by the teachings of the triumphs of Engineering skill at Home. That Cooper's Hill College is an anomaly, in the sense that it reserves to itself, exclusive of other centres of learning, the majority of the appointments in the P. W. D. of India, cannot be denied; viewed in the same light it might be said to be perpetrating an injustice, but certainly not from the stand-point which the memorialists occupy. A protest might reasonably be made against the system, but certainly not against the men, who, as a body, are above the average and possess a guarantee of training and qualifications not always obtainable here. The alumni of our Colleges should bear in mind that the defect in Indian experience can be overcome by their brethren from England, but any shortcoming as regards the knowledge of Engineering in foreign parts cannot very well be supplied in this country. If the number of outsiders imported into the Department were carefully scrutinized it would be found that officers of the Royal Engineers form no small item. There is not the shadow of an excuse for transferring to the service Royal Engineer officers who, being trained and educated for the military profession, are taken away from their legitimate duties and relegated to an already crowded department, with the inevitable result of creating a block and keeping out those who have substantial claims to those appointments. We say this advisedly,—restrict those officers to military works alone and supply local requirements by local men. The new rules for the appointment of District Engineers in Bengal, the North-West Provinces and Oudh, afford some relief to the plethora of passed men, and we have no doubt that if further opportunities are offered for an outlet to their energy and activity, they will tend in a great degree to allay the disaffection which is now eating into the core of the service. The Engineering Colleges in the United Kingdom, where technical education of a very high order is imparted, have very properly taken exception to their being left out in the cold, while the loaves and fishes of the Indian service are kept a close preserve for Cooper's Hill College. They see no reason why they should not be permitted to compete on equal terms with the only English institution that now commands the monopoly. By a parity of reasoning, the Colonies and India should also be represented in a noble

rivalry with the sister institution. Of all the methods of test of candidates for public service there is none that possesses greater advantages than open competition; but that it is accompanied by drawbacks in regard to securing complete efficiency is also admitted, so that while appointments are thrown open to competition, a judicious selection might be accorded a place in filling up vacancies in the department. The prayer of the memorialists that Government ought to provide for everyone to whom it accords the benefits of a technical education is, to our thinking, destructive of that manliness and independence of thought and action, to promote which is the special mission of an academic training, although it will readily be conceded that they are entitled to a fair chance in the race of life. This can very well be accomplished by shutting out Government Engineers from employment by private concerns, by Native States and local bodies. To secure this end more fully the development of private enterprise might be encouraged as a means of utilizing indigenous talents in the shape of Indian Engineering College graduates.

THE ROORKEE PROFESSIONAL PAPERS,—FINAL NUMBER.

It is nearly 24 years since (*then*) Major Medley, R.E., called upon all good and true men to aid him in his task of raising a worthy memorial of Indian Engineering in a scheme for the publication of a Series of Engineering Papers. The object of that undertaking was the recording from time to time of the experience of Officers of the Public Works Department in India for the benefit of contemporaries and successors.

The Papers were commenced and carried on by Colonel Medley with complete success till 1870, and were continued by Colonel Lang, who succeeded him, with corresponding result, up to 1877, when another change of Editorship occurred by the appointment of Colonel Brandreth. But, in 1879 a change came over the prospects of the Serial for the worse. "The number of contributors, the interest of the articles, and the patronage of the public," gradually diminished, till at last the freshness of the undertaking having worn off, the stock of records of important Public Works having become exhausted, and other fields for publishing Engineering experience having been opened, the "Editor finds it hard to collect information of sufficient interest to be worth publishing." Hence the Government have decided that "this publication, which in its time met a decided want, and has admirably fulfilled the purpose, is no longer needed, and can now be discontinued."

But the thanks of Government are conveyed to Colonel Brandreth, R.E., for the good services rendered by him in connection with the publication. This, however, is hardly a sufficient acknowledgment for the good work accomplished by the Roorkee "Papers" during the past 23 years. The published volumes contain a mass of information in every way worthy of the Engineering Services of the country, and there can be no question that they are the outcome of great care and trouble under much discouragement and difficulty. In the words of Medley—they not only show what has already been accomplished, but point out what still remains to be done in the country.

THE DANGERS OF JOURNALISM.

The somewhat remarkable case of "Casebourne and another *versus* 'The Engineer' newspaper," has just been concluded by the unanimous verdict of three judges. Plaintiffs are iron merchants at West Hartlepool. Defendants inserted in their issue of 8th January 1886, a letter from their correspondent for the North of England, wherein it was stated that the failure of plaintiffs' firm had just been announced. Within a few days it was discovered that this was not correct, and an ample apology and retractation was inserted the following week. The plaintiffs were, however, not satisfied with this; they claimed £10,000 damages, and brought an action to recover the same. The case was tried at Leeds Assizes in following May, and resulted in a verdict for plaintiffs, with £1,500 damages. Defendants after paying the money into Court, moved for a new trial on the ground of excessive damages. The application was heard at the Queen's Bench Division of the High Court of Justice before Mr. Baron Huddleston and Mr. Justice Manisty, on the 2nd of December. It resulted in a reduction of damages to £500 or leave for a new trial, in the option of plaintiffs; the said option to be exercised within a week. The pith of the case is contained in Mr. Justice Manisty's summing up, and is as follows, *viz*:—"This is not a case of malice; it is not a case of wanton mischief. It is a case in which the correspondent of the newspaper got information from some of the parties who were creditors on 'Change, to the effect that the plaintiffs' firm had 'come to grief'—that was the expression—not a mere rumour. As to the evidence given by the reporter, there does not appear to be any suggestion that he was not telling the truth. He was on 'Change—this was on the 5th of January. He met there Mr. Jameson—not one of the three firms (creditors of plaintiffs) mentioned in the letter. Then he sees Mr. I'Anson, of the firm of I'Anson & Co.—that is one of the three firms mentioned in this letter—and both of them stated that it was a fact, it was not a rumour; they knew it, and stated it. And that occurred, no doubt, when the fact mentioned in the letter of the plaintiffs themselves was first discussed, and became the subject of general observation. That letter was on the 29th December, in which the plantiffs say they regret to inform the firm, of whom Mr. I'Anson and Mr. Fry were members, that owing to a heavy loss they are unable to meet their engagements. It uses rather different language, but it says the firm have come to grief. Then there are enquiries whether or not the plaintiffs were on 'Change that day. It was suggested that they might as well have gone to see them. The plaintiff lives at Hartlepool, eight miles away, and the correspondent says he was so confidently informed by those who knew the fact that he did not think it necessary to make any further enquiries. Consequently, a great deal of the damage, no doubt, if damage there was, resulted from the plaintiff's own letter to his own customers, and two of those customers being on the Exchange and stating the

facts. Then, it resulted in this statement. On the 15th (a correspondence having taken place in the meantime,) there is the unconditional retraction and apology. I think this is not a case that can bear the character of having any appearance of malicious libel, or of a wanton libel, or a libel recklessly published, or a statement recklessly published. Therefore it appears to me I can well agree in the terms which my learned brother has proposed. There have been three minds brought to bear upon it, by us, without consultation with one another; and being accustomed to this sort of thing, we have come to the conclusion that £500 is an ample sum. There will be a new trial, unless the plaintiffs are willing to let the damages be lessened to the sum of £500."

The plaintiffs accepted the reduced damages and so the litigation terminated.

Notes and Comments.

INDIAN RAILWAYS.—The *Economist*, in a review of the Indian railway returns for the half-year, says that they show that the Great Indian Peninsula has again forged decidedly ahead, while the Bombay-Baroda has just held its own, and the East Indian has lost ground. The returns of the other lines are less complete, but so far as they go, they are certainly favourable in the case of the Oude and Rohilkund and South Indian lines.

E. I. R. BARAKAR EXTENSION.—The East Indian Railway Company are calling on Coal Companies with workings on the other side the Barakar river to furnish information as to the possible traffic that would accrue from the continuation of the Branch line from Sitarampur over the river. We think that there can be no question as to the remunerative aspects of the proposed extension. It would open some new coal lands which are now shut out by heavy cartage.

SEEBPORE EGINEERING COLLEGE.—We are glad to hear that as subordinates of all grades are required for the Burmah P. W. D., there is a demand for passed men of the Seebpore Engineering College. This demand is a very healthy sign, which should be an encouragement to parents who intend training their sons to the Engineering Profession. It is, however, surprising to see how few take advantage of the opportunity afforded by the Seebpore Engineering College, where instruction is imparted almost for nothing.

INDIAN EXPERIENCE A *SINE QUA NON*.—It is contended that although the young men who are sent out for the controlling staff of the Forest Department undergo a special theoretical course at Cooper's Hill, they should afterwards go through a two years' course at the Forest School of Dehra. "Indian experience is what they want, and a practical training in Indian Forestry." Even the alumni of "Nancy have been of but limited use till they have gone through a somewhat lengthened experience out here," as their previous training was "all too short and much of it gained in forests very unlike what most of them have to deal with here."

CENTRAL INDIA RAILWAYS.—Lieutenant-Colonel W. A. J. Wallace, R.E., Consulting Engineer for Guaranteed Railways, Agra, is now on tour inspecting the works in progress on the Indian Midland Railway. We learn that the earthworks on most sections of the new line are in a forward condition, and that the Gwalior-Jhansi section will probably be opened in a few months. Construction works are in progress on the Etawah-Saugor section, but the continuation of this branch from Saugor to Kutni on the E. I. R. has not yet been sanctioned. Seeing that this short length will open a direct line of communication with the Indian Midland system, there can be little doubt of its utility and ultimate economy.

PROTECTION AGAINST LIGHTNING.—Last year it was conclusively shown in the columns of a Ceylon paper that the contiguity of cocoanut trees to a building in that Island afforded effectual protection against lightning. We now find confirmation of this fact from German investigations which show that in the temperate zone the oak is most frequently, and the beech least frequently, struck by lightning, and the former tree is said to be fifty-four times more dangerous than the latter as a place of shelter in a thunderstorm. The beech, in fact, is stated to be the safest of all trees for that purpose in German latitudes, being 15 times safer than the pine, larch or fir and about 40 times safer than most other chief varieties of the forest timber of Germany.

SOUTH MAHRATTA RAILWAY SYSTEM.—Colonel Jopp, R.E., and Mr. Warden C.E., Consulting Engineers, having inspected 56 miles of the South Deccan Line of the Southern Mahratta Railways, from Dharwar to Deoli, near the Portuguese Frontier, have recommended its opening for traffic from 24th instant. This portion of the S. M. R. traverses an exceedingly picturesque piece of country, being nothing but hills and valleys throughout, and the whole length of Line is one incessant link of cuttings, curves and embankments, so that some very difficult pieces of engineering have had to be surmounted. Mr. Warden remarked, to the great satisfaction of those who had toiled hard and borne the heat and burden of the day, that this was the most perfect piece of Railway line he has had the gratification of inspecting before opening.

COLOMBO WATER-WORKS.—The Maligakande Service Reservoir, which supplies Colombo with fresh water, has again been rent in several places, when the water was allowed to pass into it from the main pipe. Cracks of a serious nature have been discovered in what has all along been considered the weak part of the design, *viz.*, the junction of the outer wall with the floor. This reservoir has up to the present date cost the Colony some Rs. 6,00,000, and it is considered impossible that such a structure will ever be made secure enough to hold eight million gallons of water. It is contended by apologists for the accident that the fault is Mr. Bateman's, the Consulting Engineer, first, for placing the reservoir in that position—on the top of a hill; and secondly, for being unaware of the effects of a tropical sun on such a substance as concrete—the material of which the tank is formed. To our view the whole thing is a gigantic failure.

IRRIGATION RETURNS IN MADRAS.—Of the ten systems for which Capital and Revenue accounts are kept, all but three, *viz.*, the Srivaikuntham anicut, Pelandorai anicut, and Madras water-supply and irrigation project, are in a prosperous condition. The surplus revenues under the Godavari, Kistna, Cauvery, Penner, and Palar anicuts and the Chembrambakam tank were 145·9, 90·9, 952·9, 19·3, 44·4, and 43·8 per cent., respectively, on the capital outlay. Under the Cauvery delta system there was a decrease of 95·8 per cent. compared with the results to the end of the preceding year, and this decrease was due to the large capital expenditure incurred

during the year, and to the heavy loss caused by floods. The small surplus of 1·2 per cent. on the total outlay up to the end of 1883-84 on the Madras water-supply and irrigation project was more than absorbed in 1884-85 by the heavy expenditure incurred in repairing the breaches caused by the floods of November and December 1884. The Sangam anicut project was only opened during the year 1885-86.

A STRANGE STORY.—There is a very pretty little row going on now on the Indian Midland Railway. It seems that the contract for erecting the girders of a certain bridge was given to a certain contractor who left his agent to get the plant together whilst he went to England till he should hear that all was ready. In England he received a telegram from the Executive Engineer telling him to come out and put the girders up. On arrival he found but one pier ready, the second only commencing to be sunk, and no girders arrived! Clearly he had been summoned six months before he was wanted. He demanded whether the Government would give him compensation for loss of time and expenses, and receiving no reply, he proceeded to erect his staging, taking photographs every week of the state of affairs. His staging will all be ready in this month, and then he intends to send in his bill for the whole job, leaving the staging at the risk of Government. The reason for the unreadiness of the pier is want of bricks. The number made last season was wholly inadequate all along the Kalpi-Jhansi section, and all the bridging and culvert work on this section is at a standstill. The embankments are finished, and the rails are being carted from point to point and laid in position. The line will probably not be opened before the end of the year.

STAGNATION IN PROMOTION—P. W. D., BOMBAY.—The Bombay P. W. D. have for years been far behind all other Provinces and Lists in point of promotion. But 1886 has changed matters somewhat for the better, for they have had no less than six steps, five by retirement and one by death, of highly graded officers:—Colonel J. M. Greig and Colonel J. R. Maunsell, Superintending Engineers, Colonel B. H. Matthew and Major M. T. Macartney, Executive Engineers, 1st grade, Mr. W. Clarke, Executive Engineer, 2nd grade, all retired—and Colonel E. P. Gambier, deceased. During the current year there will, it is thought, be three retirements—those of General Goodfellow, Colonel John LeMesurier and Mr. F. D. Campbell, Chief, Superintending, and 1st Grade Executive Engineer, respectively. To judge how bad things were last June, before this small run of promotion came in, the following figures show the length of service of the *senior* in each grade:—

Rank.	First appointment.	Years of service.
Ex. Engr. 1st Gr.	1858	28 years.
" " 2nd "	1862	24 "
" " 3rd "	1867	19 "
" " 4th "	1871	15 "
Assist. Engr. 1st "	1873	13 "

One step—that of Colonel Maunsell—still remains to be filled, but the *present* seniors of the above grades are of 28, 20, 19, 11, and 10 years' service, respectively. It is something approaching to almost a scandal that an officer of 20 years' good service, who is talented, bears a blameless reputation, and has a high University degree, should still be in the 2nd grade of Executive Engineers? Such is Bombay luck!

Current News.

THE Railway Committee which recently met in Calcutta has dissolved, and its report is now in the hands of Government.

THE Lahore Cathedral was consecrated on the 25th January afternoon by the Bishop of Lahore with great *éclat* in the presence of a large gathering.

THE plans and estimates for the Jhansi-Baroda section of Indian Midland Railway have been passed, and work will now proceed rapidly on that portion of the line.

IT is expected that his Excellency the Viceroy will perform the ceremony of opening the new Railway Bridge over the Ganges at Benares which is rapidly approaching completion.

THERE is no truth in the statement that it is intended to transfer the section of the Punjab Railway connecting Ghaziabad and Saharunpur to the East Indian Railway.

FIRST rate progress is being made with the bridge over the Sutlej at Ferozepore. The work is being pushed on with wonderful energy, and the Engineers hope the bridge will be open before the rains.

THE Quetta line by latest accounts is now close up to the Khojak, and General Browne hopes to be through with the Hurnai line to the Peshin plateau before many weeks have passed. The weather, however, has been untoward of late, and this may delay him.

THE Maharaja of Kashmir is making great preparations for the celebration of the Queen's Jubilee. A fitting permanent memorial of the occasion will be afforded in the shape of a handsome and substantial bridge across the Tawi at Jammu, an undertaking that will cost several lakhs.

THE Bombay Corporation records with regret its sense of the loss it has sustained by the death of the late Mr. Arthur W. Forde, M.I.C.E., who as Consulting Engineer to the Municipality during a period extending over many years rendered valuable services to the city.

OWING to the reduction of the grant for establishment in the Madras P. W. D. Budget for 1887-88, orders have been issued to Superintending Engineers to give all temporary engineers, upper subordinates, clerks, &c., a month's notice that their services will not be required after the end of February 1887.

THE switch system recently adopted on the Eastern Bengal State Railway is proving a marked success over the old method, as regards greater facility combined with security in working the several lines, as well as obviating the heavy expense formerly incurred in the employment of a large staff of pointsmen.

IT is suggested that no name could be more fittingly rewarded than that of the gentleman whose engineering genius has contributed so largely to the benefit of the people of this great Empire, and that the Jubilee would be a very suitable opportunity for conferring the honor of knigthood on Mr. Bradford Leslie.

MR. J. W. BUYERS, Engineer-in-Chief of the Assam Railway Survey, has been appointed Manager of the Burmah State Railway, *vice* Mr. Mathews, whose term of service has expired. Mr. Parker has been appointed Engineer-in-Chief of the Railway party engaged in the survey of the proposed extension of the Baroda line from Godhra to Rutlam.

THE preparation of Estimates has been ordered for showing the comparative cost of doubling the Rajputana-Malwa Railway or of converting it into a broad gauge line. Colonel Pemberton, Consulting Engineer for Guaranteed Railways, has been deputed to go over the line and give any general instructions required as to the sort of estimate to be adopted.

THE Madras Tank Maintenance Scheme ceases to exist as a separate department on the 1st March 1887. The post of Superintendent of Works will be abolished, and the work of the scheme taken up by the regular Divisions whose establishment will be strengthened by the posting of an extra Assistant Engineer and a couple of Overseers and Surveyors to each.

IT is stated that the Government of India have consented to the services of Mr. Bruce Foote, of the Geological Survey of India, being lent to the Government of Maisur for a short time to verify the report of Messrs. Lavelle and Marsh, who were engaged during the greater part of last year prospecting all over Maisur, and whose Report we are now producing in our columns.

AMONG the items of the Calcutta Port Trust expenditure during the past year, we notice that Rs. 21,22,977 were spent on the new works, and Rs. 34,881 for the construction of jetties and wharves for inland vessels, while Rs. 2,74,883 were expended on the tea warehouse at Armenian-ghat, and the petroleum wharf at Budge-Budge. A new anchor-vessel, a light-vessel, and a dredger, were also purchased.

THE services of Mr. J. D. Grant, Executive Engineer, Mr. E. Taylor, Sub-Engineer, and Mr. N. N. Joyce, Supervisor, have been placed at the disposal of the Chief Commissioner, Burmah, for six months for employment on Irrigation Surveys, &c. As there are numerous vacancies for Upper Subordinates in the Burmah P. W. D. the Chief in Madras has offered employment to the temporary men who will be thrown out of employ on the 1st March 1887.

Two new vessels for the Indian Marine, namely, the *Tamil* and the *Muzbee*, have arrived in Bombay. They are intended for Torpedo and sub-marine mining operations. Their tonnage is 34 net and 92 gross; and they are fitted with very powerful engines. They left England on the 15th November, and accom-

plished the voyage without serious accident, notwithstanding the rough weather. The *Tamil* will shortly go to Rangoon for mining and surveying duty.

MR. MCGUIRE, of the Telegraph Office at Umballa, claims to have made an important discovery in connexion with the working of the duplex system of telegraphy. The new process dispenses with the differential apparatus, and only requires the single acting instrument, thus effecting an economy of no less than fifty per cent. in the working of a line. If the discovery bears the test of experiment its results will doubtless be of universal importance. Meantime, the duplex system is shortly to be extended very considerably in Madras and other parts of India.

THE old Indian lists of Royal Engineers, with the new Constable of the Tower as their most distinguished member, are rapidly closing up. During the past month the last remaining majors of the Madras and Bombay lists have received their promotion, and on the Bengal list, where promotion has been much slower than in other Presidencies, there now only remain fourteen officers below the rank of lieutenant-colonels. By the luck of the Service both Lieutenant-Colonels Hamilton and Cumming (Madras list) have gained their promotion before several officers who were senior to them when they passed out of the old East Indian College at Addiscombe, and they are also several years junior in point of service to the senior majors of the Imperial list.

THE line from Jhansi to Manikpur, as most people know, is one of the branches of the Indian Midland Railway, and the first portion of this will ere long be opened for traffic—to Karwi and Banda in the first instance and later on right through to Jhansi. The activity that has prevailed during the twelve months that have elapsed since the Indian Midland has taken charge of the works is, no doubt, due to the energy of the District Engineer, Mr. Benedict; but even his talent for pushing work would have been wasted had he not been well and loyally supported by his two immediate assistants, Messrs. Merivale and Tyrrell, and by their subordinates, native and European. We congratulate the Agent and Chief Engineer of the Indian Midland Railway, Mr. A. C. Cregeen, on the vigorous prosecution of these heavy and important works.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

PROPOSED PATENTS' BILL.

SIR,—I observe in the third issue of INDIAN ENGINEERING, dated 15th January, an article on the New Patents and Designs' Bill. I fully endorse and approve of all you have written, especially in regard to the fees which it is in contemplation to impose on Inventors, and I am sure no one who is conversant with the subject will differ from you in the views you have expressed. The charge of Rs. 75 after two years and the immediate subsequent charges are certainly excessive, and will, without doubt, have the effect of precluding many Inventors from protecting their ideas. The result of this will be, that many useful inventions will not be brought to light. The aim of the Act should be to encourage Inventors and not discourage them, for in the end both the Public and the Government will be benefitted.

The subject is one on which too much cannot be written, and too strongly, but I shall not, at least for the present, burden you with any further remarks. I will only hope that the question will be taken up by others and that we shall succeed in inducing the Legislature to reduce the fees they purpose levying.

If an enhancement is necessary, the burden may be greatly mitigated by increasing the fees payable at the 6th and 8th year. Few will object to pay increasing fees after this period, if they find their inventions worthy of further protection. With the proposed high rate of fees, the greater number of patents that will be taken out will certainly be abandoned after the lapse of two years.

INVENTOR.

ARTESIAN WELLS IN BENGAL.

SIR,—In the last number of INDIAN ENGINEERING an item of news appears to the effect that the Port Canning Company has made arrangements to bore for an artesian well on their property at Mutla. This seems to call for a discussion of the geological aspect of the question involved in the problem.

Bearing in mind the vast quantity of silt carried down by the Ganges yearly into the sea, it does not require much research and reasoning to prove that at one time the sea must have been as far inland as the Rajmahal hills.

If the above be accepted, we have next to consider what must have been the primary depth of the sea at Mutla. This, I believe could not have been less than two to three hundred feet at the least.

Now, the conditions of geological strata requisite for an artesian well, appear to me to be such that they can scarcely be expected to be met with in estuary and river formations. This is my own conviction, but I am subject to correction.

The object of my communication is, that a great deal of money and energy would be saved by subjecting Engineering projects of the above description to scientific scrutiny of the most rigid and earnest kind. In your notice of the undertaking, it is not stated that this has been done, and I therefore take the liberty to suggest the course by which the Port Canning Company would be saved the chances of loss, of which I presume they have had enough already.

There is nothing, however, to show that fresh water wells would not succeed in the Sunderbuns. It is quite possible that as the sea recedes with the gradual but rapid formation of new land by the silting process above referred to, the saline matters get neutralized. River formations also contain water-bearing strata of sand which when reached afford admirable fresh or river water. At the upper reaches of a river such beds of sand are met with almost at the surface of the bed. As the river descends, strata of sand and clay alternate with variations incidental to the changes of the river bed and other circumstances. We know that besides the visible stream of the Ganges there is a subterranean stream passing through the whole delta which should be availed of as the best water supply for the districts of Bengal generally. The question of water-supply in many such districts and their towns is already engaging the attention of the authorities, though it cannot be said that sufficient attention has been given to the subject as yet.

To show how important the question of water-supply in this country is, it is necessary only to state that almost every village in Bengal is in want of a well or wells to supply pure water, the absence of which is the patent cause of the disease and untimely death of thousands.

R. R. M.

Notes and Queries.

R. writes :—There are two very interesting subjects which if fully dicussed in your *journal* would, I am sure, prove instructive to a great number of the Profession in India and interesting to all. They are—

(i). The proper method of obtaining approximately the discharge from catchment areas.

(ii). The method of obtaining widths of waste weirs in the construction of tanks and reservoirs.

Literary Notices.

MADRAS ASYLUM PRESS POCKET ALMANAC AND DIRECTORY FOR 1887.

ALTHOUGH this "annual" is primarily intended for Southern India, we can recommend it to those in other parts of the country desirous of obtaining general information relative to the Madras Presidency. The small handy form in which this information is presented makes it very convenient for reference, while the provision, made for "Engagements," "Cash Account," and "Memoranda," should be an additional recommendation to Professional men.

QUARTERLY JOURNAL OF THE GEOLOGICAL SOCIETY OF LONDON. Part 4.—November 1886.

AMONG the numerous articles that make up the present volume, we may particularise Professor McKenny Hughes' "On some 'Perched Blocks' and associated 'Phenomena.'"

The said *Perched Blocks* are defined to be masses of rock placed in more or less elevated positions at which they could not have arrived by any of the ordinary operations of nature now in action in that locality. This excludes all "tumblers" or masses which have fallen from the cliffs above, and also rocks trundled along by the mountain-torrents, which often in storm are swollen to the size of great rivers and leave small deltas of loose material or isolated blocks in positions we should never believe them capable of reaching as we watch the silvery trickling thread of water in fair weather.

But the class of blocks principally dealt with are what we may call the *pedestal boulders*. The questions attempted to be explained in connection with them are: How were the pedestals formed and how did the boulders get there?

Although the arguments are restricted to special objects, they are capable of wide application, or at least show that, as regards such phenomena, there is much in favor of the view of "no denudation except that due to the chemical and mechanical action of the rain and other condensed atmospheric moisture helped by vegetation."

Mr. Lydekker, of the Indian Geological Survey, contributes an article "On a new 'Emydine Chelonian' from the 'Pliocene of India,'" which indicates a species distinct from any of those which he has recently described from the Sewaliks.

General Articles.

RANGOON DRAINAGE PROJECT.

SHONE'S HYDRO-PNEUMATIC SYSTEM.

(Continued from last issue.)

THE power of compressed air has long since been known, but it is only of late years that its application has been extensive. At first the engines designed for compressing it were of the rudest type, resulting in giving the power a bad name, on account of the expense attending its compression and utilisation. Upon the experiences of those who used unscientific and unmechanical-like means of compressing air and using it after producing it, the prejudices of active men who had not the time nor the inclination to investigate the subject for themselves, have somewhat retarded the progress which would otherwise have been made in the development of compressed-air power. Now, however, the science and practice connected with the production and utilisation of compressed air as a motive power are well-known, and here we must not omit to add that the way in which compressed-air power is utilised on the Shone System enables its users to get the highest possible degree of efficiency out of it. On the Shone System the air before it does the work of which it is capable does not actuate an executive engine, thereby losing all the air and power necessary to actuate such executive engine or pump, but it is wholly employed in doing the work required of it. Instead of pushing the piston of an executive engine or pump backwards and forwards when it is admitted into the Ejectors, it pushes the sewage itself out. The sewage in the Ejector thus becomes a piston, which is driven downwards by pneumatic pressure out of the Ejector. When the full charge of sewage has been ejected, the charge of compressed air which has ejected it escapes into the atmosphere through the exhaust ports of the automatic gear. The compressed air does not, as some have imagined, follow the sewage into the outlet pipe or sewer. If it were allowed so to do, it would get mixed with the sewage in the outlet sewer, and be a source of great, if not unsurmountable difficulties, as it would collect at certain points in the outlet sewage main and contract the bore of the pipe, making it impossible to discharge sewage full bore right away to the outfall as it is intended to do. It would lengthen this Report unnecessarily, and it would answer no purpose for the general reader, if we entered into a full disquisition of the economies of the Shone System and entered into calculations to show that compressed air utilised through the medium of the Ejectors will not only compare favourably with steam power employed for water-pumping purposes, but that it will, when pumping power or its equivalent is required at several places at one and the same time, be much more economical than steam pumping. Mr. Clark, after what he has seen of the Shone System in England, will be able to explain this more clearly and fully, verbally to you than we can in this Report.

For the benefit of those who are unacquainted with the way in which power is derived from atmospheric air, we will give a simple illustration.

If we had one cubic foot of the atmosphere when its pressure was 14·7 lbs. on the square inch in a cylinder, and introduced an air-tight piston into one end of the cylinder, the other end being closed for the purpose of compressing the one cubic foot of free atmospheric air into half a cubic foot, we should find that the operation would result in our having half a cubic foot at double the atmospheric pressure of 14·7lbs., equal to 29·4 lbs. on the square inch. If we applied this half of a cubic foot of compressed air to the surface of sewage contained within what we call a Pneumatic Sewage Ejector of a capacity equal to half a cubic foot, the spring-like action of the compressed air would force its equivalent volume of sewage—*viz.*, half a cubic foot—out of the Ejector to a height of 34 feet, which is the height of a column of water that a pressure of 14·7 lbs. on the square inch above the atmospheric pressure will balance. This is the principle upon which the air is compressed and applied. We have an inexhaustible reservoir of air in the heavens to draw from. The air compressor is like a pump which draws water into it by suction, and forces it out of it by pressure. The compressor, however, instead of drawing water into it, and forcing it out of it again into the rising or delivery main, draws atmospheric air into it, and forces it out into air receivers or accumulators, and these discharge it, into the air-pipes, which carry it to the Ejectors. The total percentage of the volume of compressed air which is lost in actuating the automatic gear connected with the Ejector, and which is lost in clearance and otherwise, is a mere bagatelle, and need never exceed one per cent., and as it is applied direct on to the surface of the fluid its whole power is thus exerted, and that without loss from friction due to the expulsive act of the Ejector itself. The degree of economy realisable by the use of the Ejector increases as the number of stations at which it is desired to pump increase, because it matters not how numerous and widely apart the Ejectors may be, they can be operated from one air-compressing station with the same facility and economy practically, and with the same unerring certainty of automatic action as if there was only one Ejector Station, and that close to the air-compressing plant.

The following table, which we have copied from the *Engineer* of the 27th June 1884, gives estimates calculated on the basis explained in the article on the Shone System in the *Engineer*, of the ratio of work done in raising water for various degrees of compression from one-half to four atmospheres absolute.

Lift in Feet.	Isothermal Compression.			Adiabatie Compression.			Mean value of column 3.	Mean value increased by 25 per cent.
	1	2	3	1	2	3	4	5
16½	859	706	1·22	900	802	1·12	1·17	1·46
33	1,467	1,058	1·39	1,500	1,300	1·15	1·27	1·59
49½	1,940	1,270	1·53	2,150	1,657	1·30	1·42	1·77
66	2,328	1,411	1·65	2,700	1,970	1·37	1·51	1·89
82½	2,650	1,512	1·75	3,200	2,166	1·44	1·59	1·99
99	2,938	1,587	1·84	3,620	2,376	1·52	1·66	2·08

Columns 1 give the work done in feet and pounds by the prime motor in compressing one cubic foot of free air.

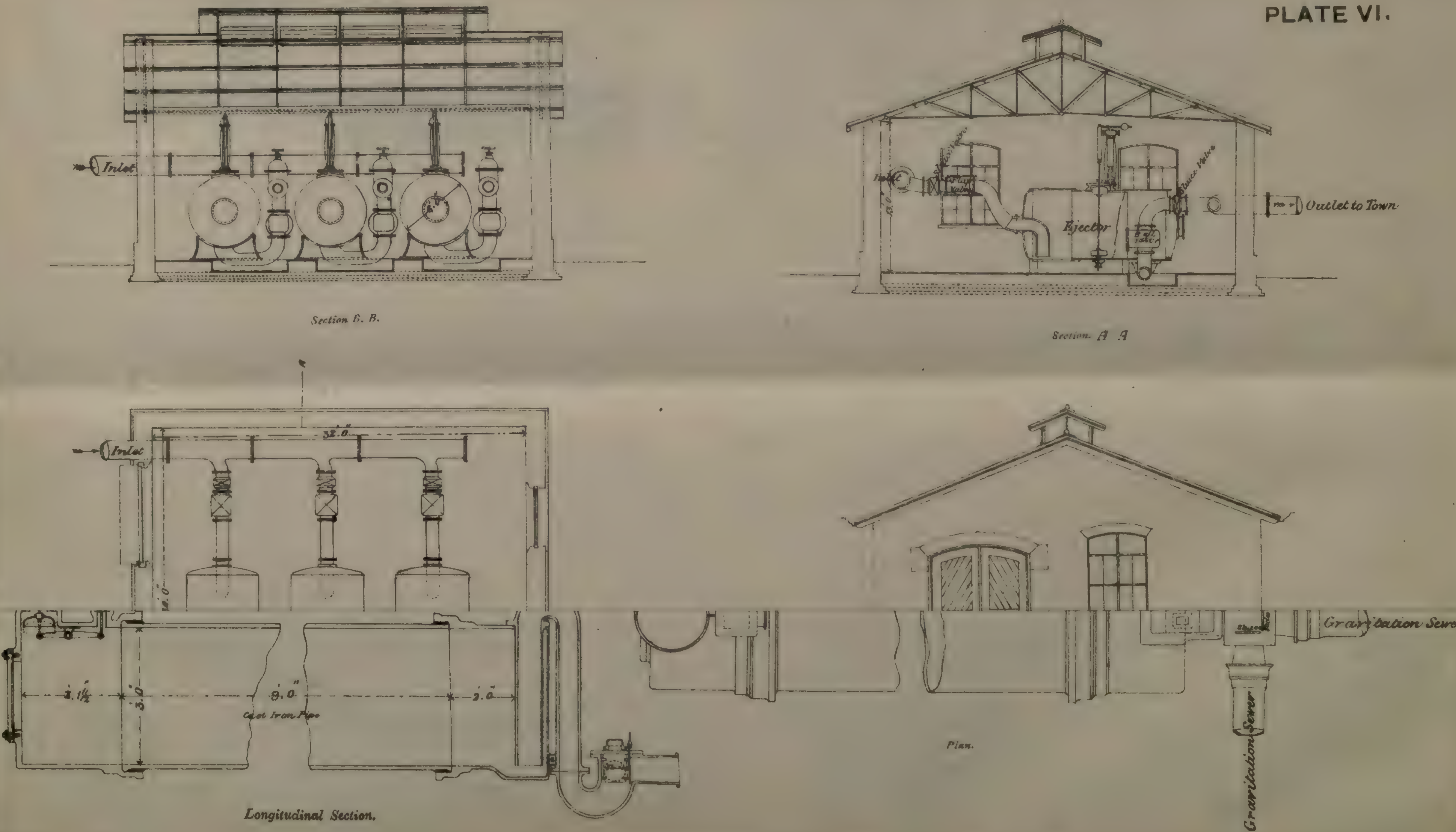
Columns 2 give the work done in feet and pounds in net weight of water raised.

Columns 3, the ratios of values in Columns 1 to those in Columns 2.

Engineers generally estimate the power which steam pumping engines must indicate in the steam cylinder by doubling the calculated horse-power in weight of water to be lifted; and although we find from the above table that this would be an excessive allowance to make, especially for low lifts, we nevertheless base our estimates for Rangoon upon that mode of getting at the horse-power required.

By way of proving to you that pumping is a necessity, and that the sewage of Rangoon cannot be got to Monkey Point by gravitation alone, we have prepared the longitudinal section shown on Drawing No. 8, Diagram B.—to follow. The dotted line below the surface shows the inclination which should be given to the main outfall sewer if the sewage were passed away sanitarily properly to the outlet at Monkey Point, and the outlet was always free and above high-water mark at that point—a thing, it is needless to say, impossible. The law of hydraulics is inexorable. You *must* lay your gravitation sewers at the inclinations indicated by the red dotted line, or the sewage will never flow through them at the pace known to be absolutely necessary to render them self-cleansing, free from deposit, and *ergo* free from dangerous sewage smells. But you would decline to so lay them because of

PLATE VI.



The "Star" Press, 19, Lall B

the expense it would entail in cutting the trenches and forming the connections with such main sewers, to say nothing of the cost of sinking a shaft and pumping the sewage to high-water mark, as you would be obliged to do in such a case, after it arrived at Monkey Point. A project of this kind would at once be set aside as being out of the question; so also would be the alternative plan—that of lifting the sewer bodily above the surface and carrying it on an embankment, as per blue dotted line! Besides, this latter plan would necessitate a number of pumping engines, otherwise the sewage could not be got into the gravitation sewers at all! But by the project we submit to you the sewage will flow out at the outlet at Monkey Point as fast as it flows to the 22 Ejector Stations, whether the tide is in the river or not. Moreover, our outfall sewer, instead of having to be laid at impracticable depths below the present surface, as per red dotted line, or at impracticable heights above the present surface, as per blue dotted line, need only be laid at the same depth below the surface, as your water-mains are laid. The way in which the Ejector System meets these difficulties will be seen by a reference to the Diagram B, which shows that our outfall sewer follows the contour of the ground, and is kept at a uniformly shallow depth below the surface, as if it were a water or gas main. Our outfall sewer, too, instead of emitting foul and dangerous sewage gas *en route* to the outlet, as a gravitating sewer could not fail to do, under the very best conditions as to ventilation, would be as devoid of sewage effluvia as your water-mains are!

The estimate made by Mr. Clark of the present and prospective populations which will be benefited by our sewerage project for the town proper enables us to calculate the power that will be required to eject the sewage on the Shone System.

(To be continued.)

A SCRAP.

The Right Hand and the Left.

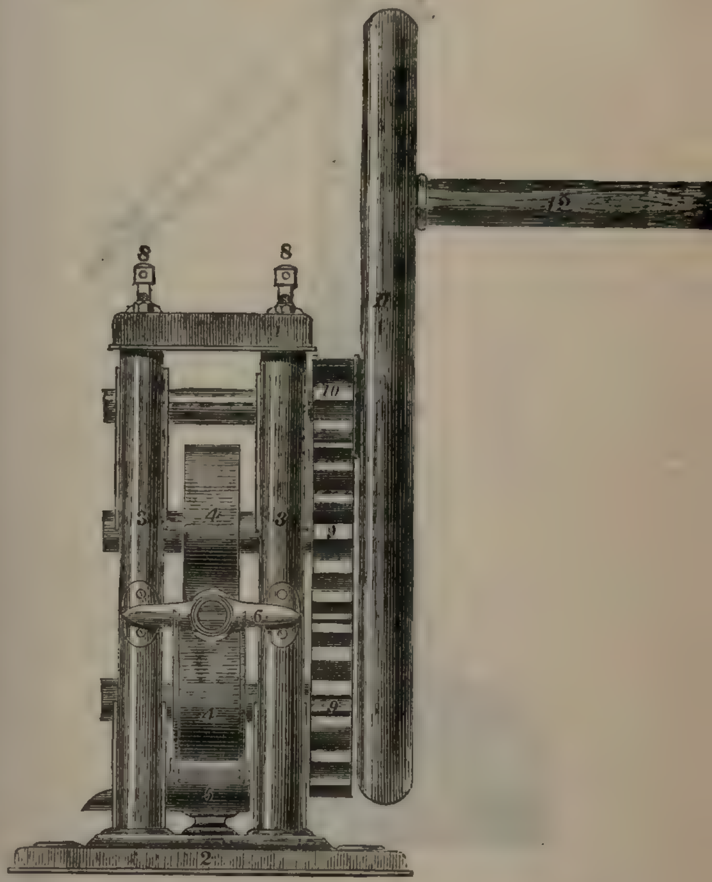
It is a curious fact that every nation, savage or civilised, has chosen to regard the right hand as more honourable than the left. I think the following considerations help to explain this point. Savages always exalt the art of fighting over ordinary peaceful industries. Also, either by passing through the phase of cannibalism or in the ordinary course of their contests, they acquire a good idea of the inside of their bodies. They are not like a lady who recently wrote the following remonstrance to the mistress of a school where her daughter was learning physiology—and perhaps showing off her new acquirements to the astonishment of the domestic circle:—

"Dear Miss C.,—Please do not let Mary Ann learn anything more about her inside. It isn't any use and besides it's rude."

Savages generally differ from Mary Ann's mamma in thinking that a knowledge of one's inside *is* of use. Long before chain armour was invented, they had discovered that a poke with the spear would be more dangerous on the left side—where the heart is—than on the right. They naturally, therefore, shielded their left sides with the left arm or with such a regular shield as savages can easily make out of the skins of wild animals. Thus the right hand became the hand to hold the sword or spear. The spear hand which dealt the fatal blow to an enemy would even come to be honoured above the less active left hand. The reason for reserving the left arm for defensive purposes would gradually be forgotten, especially when metallic armour freed the left arm or when gunpowder made it impossible to ward off the coming missile. The warrior would naturally use his most honoured hand if he wished to show respect in saluting a warrior friend. The custom thus started took care of itself and now a (non-military) Hindoo would only use his left hand to salute if he wished to pay a mark of particular *dis*respect.

A. E.

AUGIER'S SUGAR CANE-MILL.



The rollers of the new Cane-mill shown above work within the frame, and their axles are supported by suitable bearings on the outside of the frame. On one side the axles of the rollers project sufficiently to allow of two spur wheels to be keyed on them, and these interlock and give motion to each of them. Over the topmost spur there is a pinion which gears with it; this pinion is about half the diameter more or less of the spur gear with which it interlocks. A shaft with suitable bearing supports the pinion, and this shaft is parallel with the rollers and their axles. On the side of the pinion, and next to it on the same shaft, is fixed or keyed two arms projecting at right angles. These arms are weighted at their extremities and answer the purpose of a fly wheel; and at a suitable distance on one of these arms is fixed a handle or crank for giving motion to the machine.

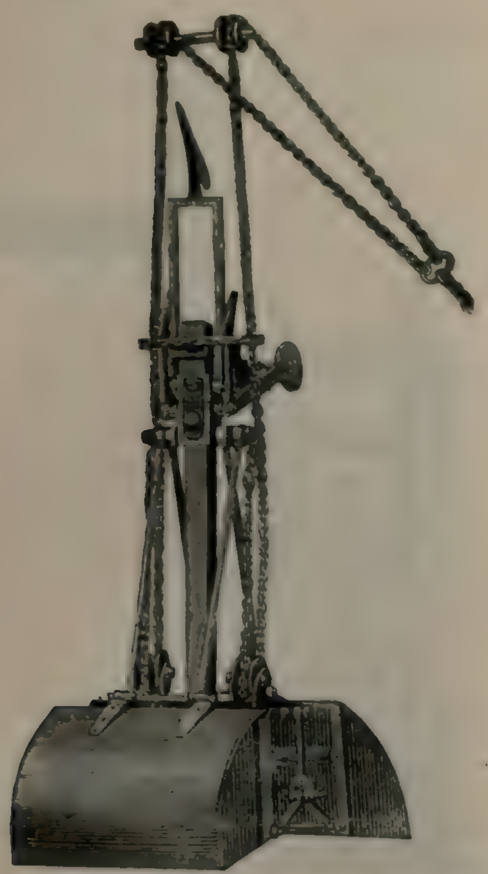
The rollers are adjusted by two vertical screws which abut on the bearings of the pinion shafts; these in turn press on the bearings of the topmost roller. A guide bar placed mid way between both rollers has a single round hole for the introduction of the canes one at a time. A suitable receptacle for holding the juice is fixed under the bottom roller.

Two scrapers made of thin sheet metal—one on the guide bar for the top roller and one on the juice receptacle for the bottom roller, for clearing them of any cane trash that might adhere to them—complete the machine, above described.

The illustration annexed represents the Sugar Cane Mill. No. 1 is the cap fixed on to the gas standards Nos. 3 3, by bolts and likewise fixed to the pedestal No. 2. The two rollers Nos. 4 4, are turned by the cog wheels Nos. 9 9, which are worked by the pinion No. 10, to which is attached the fly wheel No. 11, and handle No. 12. Nos. 8, 8, are the regulating screws, No. 6, the single cane guide, and No. 5, the juice trough.

The advantages claimed are:—1. Monumotive power applied to a handle or handles and transmitted by suitable gearing (toothed) to work the Mill. 2. Horizontal narrow rollers sufficiently broad to crush one cane at a time. 3. Flanges or raised edges on either side of the bottom roller, its use is to conduct the cane juice to the trough. 4. The use of gas-piping for the standards or frame whereby strength with lightness is secured or obtained. 5. The general combination and arrangement of parts as substantially set forth and described.

MARCHANT'S EXCAVATORS.



DESCRIPTION.—Each half of the bucket hinges in the centre of each side, so that each cutting edge describes a circle of its own, and in so doing leaves the surface of the mud nearly flat. The frame on which the half-buckets are hinged has a strong heavy square bar securely fastened to it, on which slides the automatic gear.

The first slide on this shaft is near the buckets on which the two chain pulleys are fixed and a lever and two links are attached to each end. The end of the links are fixed on to the cutting end of the hinged side of the half-bucket, which when the chain rises the first slide draws in the edges of the half-buckets to the centre, thereby helping to close the bucket. The second slide has four arms attached, two ends of which are fixed on each side of the bucket. The end of the chain which goes around the pulleys on the first slide is fastened to the second slide, which, when it is pulled down by the chain, presses the arms on to the bucket which together with the pull, or the links, on the first slide closes the bucket and holds it tight as long as there is any pull on the chain.

On the second slide two pauls or hooks are attached, which have a counterbalance weight. These clip across the bar fixed on the top of the square bar, thereby holding up the arms attached to the bucket.

There is a third slide on the bar to which is attached a long forked hook or paul. This slide is also attached to the second slide by two plates, the bottom part of which has a slot in which slides the bolt which fastens it to the second slide. In working the dredger it is lowered down, as shown above, the two small hooks that catch in the top cross bar and keep the dredger open, fall back directly the buckets touch the ground. The rods force the second slide up slightly, which relieves the weight off the hooks, and the counterbalance weights pull them from over the bar; the chains are wound up, and as the hooks are now hanging out of gear, the second slide is pulled down, and the first lifted up, which closes the bucket; the bucket rises until the long hook catches the crane—jib. It is then swung over the place where it is required to be discharged, the chain is lowered, and the hook catches the jib and pulls up the second slide, which opens the two halves of the bucket through the arms which connect them. As the bucket opens, the square bar, which is connected to the centres, comes down, and the cross bar slides under the small hooks (which are brought up into position again when the large hook catches the jib), the chains are again wound up, the large hook falls out of gear and the dredger is lowered.

The advantages claimed for this excavator, over those of other inventors, are :—

1*st.*—That by the method of centering, the excavator when open, covers one-and-a-half times more area than those that have a common centre for both jaws.

2*nd.*—The bite is shallow, and the cutting force is pretty even throughout.

3*rd.*—The power is multiplied by passing the chains over the pullies connected to the lower cross-head, and besides the advantage of almost equalizing the cutting force throughout the bite, the dredger allows the weight of the excavator to act to the greatest advantage, while the jaws are closing, and if worked with the centre bar fixed to the crane (as is also possible) the power obtained for penetration and closing is enormous.

4*th.*—The action of opening and closing is perfectly automatic. The head-piece of the crane (or whatever is used for hoisting) is arranged, so that the hook of the excavator catches on it when hoisted full up. If the chains (which are joined and form one before reaching the crane or winch barrel) are then slackened, the bucket opens and discharges its contents. The same chain is then hoisted and the hook which previously held the dredger up, falls out of the perpendicular just clearing the bar; the dredger is then lowered, but is not quite opened out; but as soon as the cutting edges touch the material to be acted upon, it opens to its full extent. This opening action, which is caused by its weight, automatically raises the lower set of hooks above the cross-head, with which they were in gear, and they are drawn back by the weights at the end of levers connected to them. The chain now being hoisted, causes the bucket to close, and the excavator is raised until the top hook gears with the crane top, which completes the action.

From the above description of this dredger, it will be seen that the lowering, closing, raising and discharging, are all controlled by one chain. The price for 6 cubic feet capacity is, we learn, Rs. 500; and Messrs. Burn and Co., Howrah, are the sole makers for India.

REPORT ON THE AURIFEROUS TRACTS, MYSORE.

KOLAR SERIES.

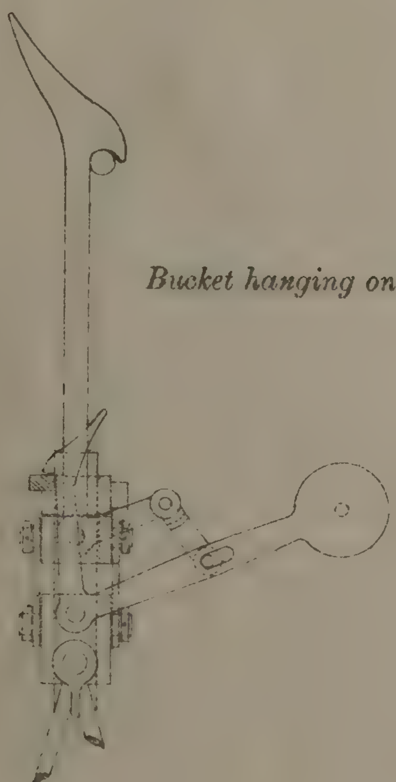
(*Continued from page* 33.)

No. 3 *Series.*—This is a line of reefs 3 in number running parallel to each other passing to the West of the "Madras" Company's property along the rising ground over "Kolar," "Mysore" and "Urigam" properties, and keeping its course to the West of the "Balaghaut," and through a portion of the "Nine Reefs" property, crossing the public road from Kolar road station to Betamangalam, West of a small anche house or runners' hut and East of the Karpenhalli fuel plantation, cutting on the granite band that runs from Mulbagal to Karpenhalli. This series of reefs was worked by the ancients in 3 places, commencing at the South, first to the West of the "Kolar" Company, again about ½ mile West of the present "Urigam" mine, then again to the North of a watercourse leading to the tank on the North of the "Nundydroog" Company's property, the extreme north working on this series of reefs being on a rising ground lying to the North-East of the Karpenhalli fuel plantation. This last working is one of the recent ones on the field and was only abandoned by the order of General Cubbon. The latter old working and the reefs surrounding it have been tested by Mr. Thomas Bray and several other Australian miners who declared it to be one of the most likely portions of this section of the Kolar gold fields to yield a large quantity of gold. After Mr. Thomas Bray's return to Australia he wrote several times about this old working and the country surrounding it, urging on me the advisability of opening up this old mine with the aid of a few friends, but not to let

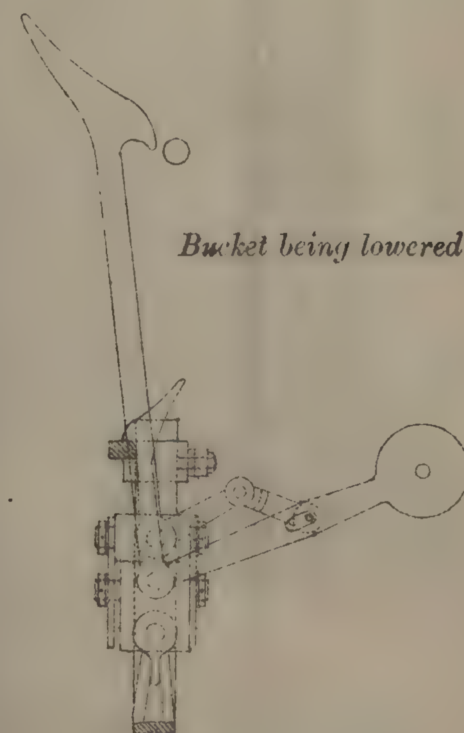
MARCHANT'S PATENT DREDGER.

(6½ cubic ft. capacity.)

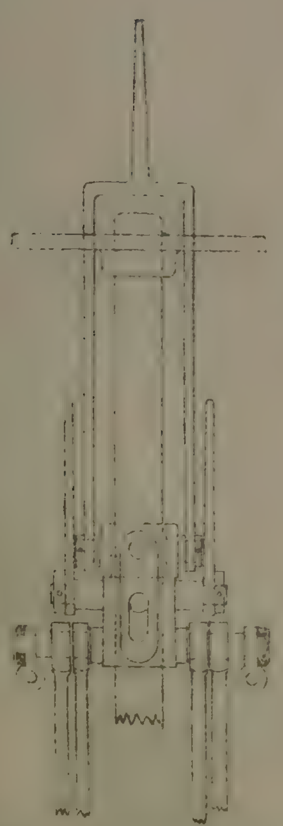
SCALE :—9 INCHES TO 1 FOOT.



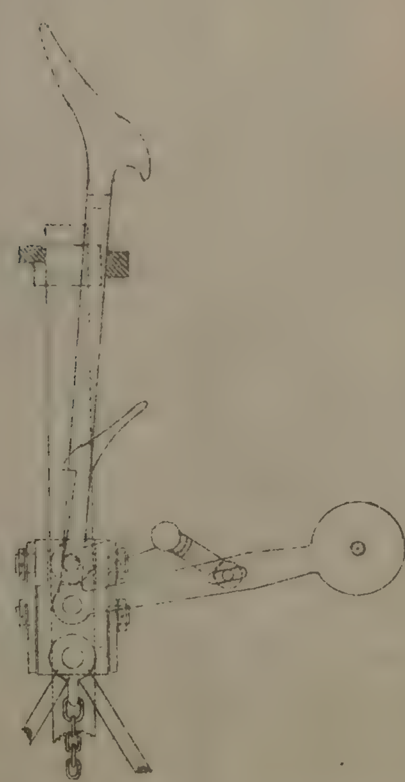
Bucket hanging on Jib—full open.



Bucket being lowered.



Position of Gear when Bucket is coming up full.



The "Star" [illegible] Street [illegible]

it into a large company, as he considered it a very valuable property.

No. 4 Series.—This series commences on the Western slope of Yerrakonda Hill in the Mysore Territory and runs South for about one mile to the boundary of North Arcot in the Kangundi Zamindari and West as far as the boundary of the "Madras" property. The first old working on the South of this series of lodes is about 1 mile due South of the "Madras" Company's buildings. Here a great number of shallow workings have been made on a small hill immediately South of this Company's property. These old workings are, in my opinion, upon the "Champion Reef." To continue a description of these workings to the North, the next working come upon is under a trap dyke lying about half a mile South of the old "Madras" Company's buildings. The Company put down a trial shaft at this old working, but I fear upon the wrong side, as the shaft was to the East of the old workings, while the dip of the reef was to the West. Proceeding North as far as the old camp, another large old working exists. Here the "Madras" Company first started their works and sunk some shafts. Proceeding still further North to the "Kolar" property, several old workings exist on this lode and the "Kolar" Company are now working on it. From here to "Balaghaut" to the North are several ancient workings which are well known now to the various companies to which the properties belong. This lode or reef is called the "Champion lode." The No. II. lode of this series is first found in the Mysore Territory close on the boundary of Kangundi on the rising ground which forms the Western slope of Yerrakonda passing to the East of the new bungalows of the "Madras" Company and running North through the "Great Southern of Mysore," "Mysore Reefs" and "Kolar" Companies' lands to the East of their present workings, and those of the "Mysore" Company, East of the Urigam Tank through the "Coromandal" block through the East corner of "Balaghaut" crossing the public road from Bowringpete to Betamangala, West of the village of Kamdepalli and under the tank of the same name, passing again North into the "East Byatarayaswamikonda" block, and butting upon the granite of the Mulbagal Range which runs West. The old workings commence on this lode at the Kangundi boundary and are to be found again to the East of the new bungalows of the "Madras" Company. This is a very long series of old workings. Another old working is to be found to the West of Mr. Moon's bungalow in the adjoining property, and some small old workings in the "Kolar" Company's land. Passing on the rising ground to the East of the "Mysore" Company's present main shaft, this reef is again worked upon the "Nundydroog" property and known as the "Urigum Gani." This gani or old working lies to the North of the present "Nundydroog" working and near their reduction works. This is one of the recent workings abandoned by the order of General Cubbon. Several small old workings are also to be found on this reef near the tank and close to the waste weir on the North-East flank of this company's property. In the "Coromandal" block two small old workings are also to be found on this reef, and in the extreme North of the "East Byatarayaswamikonda" block, this reef has been worked again by the ancients.

No. 5 Series.—This series of reefs commences on the Northern corner of Yerrakonda, slightly West and running East for about one mile and having the Butterpalli village about its centre. The first old working on this series to the South is upon a cross reef which takes an Easterly and Westerly course for a short distance, then conforming to the true run of the whole field, *viz.*, 10° West of North or 350°. This was one of the recent old workings also stopped by the order of General Cubbon. From this old working, when declared to contain no gold, at the time when Mr. Hoggin was Manager (not by him, but by his miners) I picked out from the surrounding heaps, several pieces of quartz containing visible gold. This old working is reported by the natives to be of very great value, and one of them, who was quite a boy when it was worked, gave me a very fine sample of quartz when I first visited the field, which he said was taken out from this gani (old working). This reef, with four more, passes through "Simon's" and "Middleton's" block and was worked on near a small tank on the rising ground about one mile South and East of the "Urigam" Company's works, taking its course North of the South-Eastern boundary of the "Urigam" property, and passing along the South-Eastern boundary of the "Coromandal" block. The reef is cut off by the gneiss at Peddapalli. It again occurs to the North and East of the Kamdepalli village, butting on the granite of the Mulbagal range to the North. I have found small traces of copper in the centre lode of this series—the only copper I found in this district.

(To be continued.)

PRACTICAL RULES FOR ESTIMATING.

By Lala Ganga Ram, A. M. I. C. E., M. I. M. E., Executive Engineer, P. W. D., Panjab.

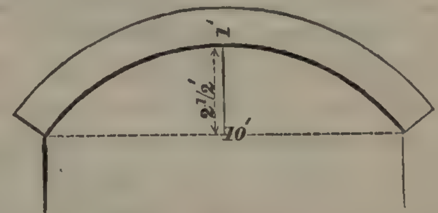
1. *To find the length of any curve:*
Add the chord and the versed line.

This will be found quite near enough for all practical purposes in ordinary calculations. Perhaps in estimating big bridges, it would be better to go into the theoretical method, but even then the results obtained by the above rule will be found useful for checking the figures obtained by the other.

2. *To find the area of any curve:*
Multiply the chord and the versed line and take 2/3rds.

This is also an approximate rule, and as already remarked in the first case, should only be used for checking purposes in the estimates of big bridges.

Example:—



(*a*) For calculating brickwork, we want the length of the mean arc.

Mean chord = 11′ (a little under);

Mean versed line = 3′;

∴ Mean length of arc = 14′.

The correct result obtained by a long process is 13·1.

(*b*) For the purposes of deductions, to find the area of the above segment.

By the above rule, area required $= 10 \times 2\frac{1}{2} \times \frac{2}{3}$
$= 17.$

Correct figure 18.

Generally speaking, the *length* is required to find the contents of masonry, and the *area* for the purposes of deductions. The practical rules above given will give results slightly in *excess* in the former case and slightly *under* in the latter. The error will therefore be always on the safe side, and quite inappreciable in many cases.

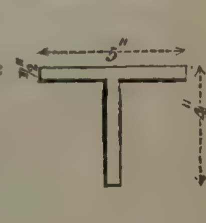
The rules are equally applicable to curves of all shapes, circular, elliptical, parabolic, &c., &c.

3. *To find the weight of iron work:*

It often happens that we find ourselves without Molesworth or any other professional companion, and at the same time we have to calculate the weight of a piece of ironwork. A very good practical rule is given for this, in Rurkee "Treatise on Civil Engineering," to which I would call the attention of the Profession, and which can be easily committed to memory.

"*Ten times the sectional area in inches gives the weight in lbs. per yard.*"

For instance take a piece of T iron.



The sectional area $= (5+4)\,\frac{1}{2} - (\frac{1}{2})^2$
$= 4{\cdot}5$
$- {\cdot}25$

$= 4{\cdot}25$

∴ weight per yd. = 42·5 lbs.
do. per foot = 14·17 „

G. R.

NOTES FROM HOME.

(*From Our Own Correspondent.*)

The report of the Committee appointed to frame a scheme for the Imperial Institute has been published to-day. It is recommended that the Institute be divided into two sections, one for India and the Colonies, and one for the United Kingdom. The Committee advise that the South Kensington site be adopted, pointing out that whilst this may be secured for virtually nothing, the cost of the ground alone in a more central position would amount to at least half a million, which would probably so cripple the finances as to leave an inadequate sum for the erection of the necessary buildings. There is, however, a strong feeling existing, not only in London, but in India and the Colonies against the South Kensington site and in favour of a more central position, and there is, therefore, no doubt that this recommendation of the Committee will meet with opposition.

The Committee in their Report give some interesting details of the costs of various sites in the Metropolis. It appears that the five acres secured for the new Admiralty are valued at £820,000 or over £160,000 an acre. The vacant plot of land in Charles Street by the India Office would cost at least £125,000, and 2½ acres on the Thames Embankment were offered for £400,000.

The lighting of trains by electricity is making further progress. The London, Brighton and South Coast Railway, who have had running for some time past a suburban train lighted by electricity, have now resolved to extend this experiment; whilst at the same time a careful trial of oil lighting under approved appliances will be made. On the 1st of January twelve selected trains, which have been fitted up, will commence running; six of these will be lighted with the electric light, and the remainder with lamps supplied with colza oil and wicks of the best quality carefully selected and trimmed. In the electric lighting system, the dynamo is driven from the axle of the guard's van by the momentum of the train itself, thus filling the accumulators in the same van. The result of this experiment will be looked forward to with interest by all Engineers. The cleanliness and brilliancy of the electric light are strongly in its favour, and if, after this exhaustive experiment, it is found that the constancy of the light can be relied on, a most important advance in the lighting of railway trains will be attained.

Sir Thomas Douglas Forsyth, who died at Easthourne on 17th December, was well-known in connection with Indian affairs, was born at Liverpool in 1827. He entered the B. C. S. in 1848, and in recent years took a great interest in Railway matters, being Chairman of the Southern Mahratta Railway Co. and a Director of the East Indian and Scinde, Punjab and Delhi Railways.

The traffic returns of the English Railways are, on the whole, fairly satisfactory, and seem to show that there is some ground for the general hope that the long depression of trade is now showing signs of passing away. Up to the present date the Lancashire and Yorkshire Railway shows an increase on the half-year of £75,395 over the corresponding half-year of £875. The London and North-Western has an increase for the same period of £60,268. The London, Brighton and South Coast, £49,627; the London, Chatham and Dover and South-Eastern about £26,000 each, and the Great Eastern almost a similar increase; but, on the other hand, the Midland, the pioneer of cheap fares and third-class facilities, has a decrease of £120,399 and the North-Eastern of £46,092.

The first half of the new Exchange station at Liverpool was opened last week. It has frontages to Titheburn Street and Bixteth Street and is built of stone and granite in the Italian style. The approaches to the platforms from both thoroughfares are on extremely gentle gradients, and are a vast improvement on the old steep inclines and numerous steps by which the passengers had to get to the platforms.

A novel engineering experiment was accomplished at Bolton recently by Messrs. Kershaw at their Derby Street Mills. They have for some time been in want of extra accommodation in connection with this mill, and as the site is limited the firm conceived the idea of underpinning the whole of the present building and constructing beneath it an entire new story. The present building is three stories high and the machinery and shafting in each story have been running as true as ever during the whole time of the alteration.

Experiments have lately been made with a submarine vessel, named the *Nautilus*, now lying in the Tilbury Dock, and, as far as space and circumstances permit, the trials go to show that in these the inventors have at least demonstrated the feasibility of a submarine boat. The *Nautilus* is cigar-shaped with a look-out or conning tower on the top, 2 feet high, with peep-holes on each side. Her dimensions are 60 feet long and 11 feet from the top of the tower to the keel. The peculiarity of the invention is in the mechanism by which she is floated or submerged, the principle being that of contraction and expansion suggested by the muscular action of fish. On each side of the hull are four apertures from which four cylinders, two feet in diameter, are projected 18 inches. When they are out, the displacement of the vessel is of course proportionately increased and the vessel rises to the surface, and when they are withdrawn the buoyancy decreases and it gradually sinks. These cylinders are worked by screws with a wheel or lever power which can be turned by hand or electricity. As an auxiliary to the projectors the *Nautilus* is fitted with water ballast, which may be pumped out if necessary, and in the case of an absolute break down a heavy keel can be displaced, enabling the vessel to rapidly rise to the surface. It is said that the *Nautilus* can run eight or ten knots an hour, and carries electrical power in her batteries capable of runnng eighty altogether. The inventors are very sanguine as to the future of this vessel and of the system which she represents. All that need be said here is, that the experiments, witnessed by officials and experts, demonstrate the adoption of those principles which makes the ship a novelty.

BURMA.

(*From Our Own Correspondent.*)

Progress is steadily being made in the direction of the Mandalay-Toungoo Railway. The construction from 11½ to the 41¾ mile from Mandalay is now taken in hand, and Mr. T. E. Owen, Executive Engineer, is pushing on the earthwork, &c., while rolling stock and iron works for bridges, &c., is fast coming in from England. Mr. W. Algie, lately on embankment duty in Egypt, has arrived, and it is believed will be sent to superintend the breach filling of the Mandalay Bund, which was lately a sore subject to the Public Works officials at that place.

The Royal Engineers under Lieut. Ellis of the Submarine Defence Works, are now blowing up the wreck of the S. S. *Shwayloung* which lies in the channel opposite Monkey Point, below 5 fathoms at low water. Dynamite is being used for this purpose, and as this explosive is a novel one to this Port, every precaution is being taken for the safety of all concerned; and the proceedings are watched by scientific and professional men.

A new company has been formed called the "British Burmah Construction Company," the Local Agent being Mr. Robert Gordon, a retired Executive Engineer of this Province. He is now *en route* to the Ruby Mines in Upper Burmah, accompained by the stone expert, Mr. Streeter, Jr., from London, and also a few mining and mechanical Engineers. This company has obtained the lease of the mines from the Supreme Government, at a yearly rental of 4½ lakhs.

At a recent public entertainment given at this station, the Royal Engineers treated us to a display of the electric light, but the attempt was a failure. A 5 H. P. portable engine being used as the motive power, connected with the dynamo machine, by means of belting, which was found insufficient, although the bearings on the shaft of the machine were so great as to bend it.

One of the most enterprising gentlemen of this city kindly showed me a small machine which he uses successfully for the same purpose, and I have pleasure in bringing it to the notice of your readers. The Engine is only a 2 H.-P. "Compression Gas Engine," horizontal in type. It has 2 fly wheels, and makes a working stroke every revolution. The governor regulates the amount of gas before every stroke. Economy appears to be the rule. The engine is noiseless; durabilty is stamped on the whole apparatus, and its best feature is that it requires no heavy foundation to rest upon; it only weighs 18 cwt and costs about Rs. 1,000.

The Iron Jetty and Pontoon lately contracted for by Messrs. John King & Co. for Rs. 7,500 has been very satisfactorily erected by Mr. Simpson, a representative of this firm, and the structure is a decided improvement on similar works at this Port.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, January 22nd, 1887.

Major A. D. McArthur, R.E., Superintending Engineer, 3rd class, temporary rank, Bengal, reverted to his substantive rank of Executive Engineer, 1st grade.

The services of Captain J. Burn Murdoch, R.E., Executive Engineer, 4th grade, sub. *pro. tem.*, and Officiating Deputy Consulting Engineer for Railways, Bombay, are placed temporarily at the disposal of the Military Department.

Punjab, January 20, 1887.

The following temporary transfers have been made:—

Mr. H. V. S. Baker, Executive Engineer, 3rd grade, to the 1st Division, Bari Doab Canal, which he joined on the 29th November 1886.

Mr. W. P. Brodie, Executive Engineer, 2nd grade, to the 1st Division, Bari Doab Canal, which he joined on the 21st December 1886.

Madras, January 18, 1887.

Mr. J. Traill, Executive Engineer, 3rd grade, sub. *pro. tem.*, is granted six months' special leave on private affairs from date of departure, under section 61 of the Civil Leave Code.

Mr. W. Jopp, Executive Engineer, 4th grade, temporary rank, is granted furlough for fifteen months from or after 1st April 1887, under section 50 of the Civil Leave Code.

Bombay, January 20, 1887.

Mr. H. W. Warden to act as Under-Secretary to Government, P. W. D. (Railway), until further orders, *vice* Colonel K. A. Jopp, R.E., proceeded on special leave.

Mr. D. Ffolliot Powell, class IV. of the Superior Revenue Establishment of State Railways, attached to the Rajputana-Malwa Railway, has been granted leave on medical certificate to Europe for one year from such date as he may avail himself of it.

Colonel J. G. Lindsay, R.E., Chief Engineer, Southern Mahratta Railway Company, is granted special leave out of India for six months from 4th March 1887.

N.-W. P. and Oudh, January 22, 1887.

Mr. H. C. E. Vernon, Executive Engineer, 3rd grade, Lucknow Provincial Division, is granted extraordinary leave, without allowances, for two years, under chapter II., section 16 of the Civil Leave Code, 6th edition, with effect from the 1st March 1887, or subsequent date.

Irrigation Branch.

Mr. C. Hill, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India furlough to 19th October 1887, in extension of the furlough granted him in Notification No. C.2614E.I., dated 12th October 1886.

Mr. H. J. Strickland, Assistant Engineer, 1st grade, is transferred from the Narora to the Etawah Division, Lower Ganges Canal.

Mr. H. J. Bacon, Assistant Engineer, 1st grade, sub. *pro. tem.*, Northern Division, Ganges Canal, passed the Lower Standard Examination in Hindustani on the 4th October 1886.

Mr. H. G. Boyce, Executive Engineer, 4th grade, sub. *pro. tem.*, is, on return from furlough, posted to the 3rd Circle, Irrigation Works.

Mr. G. T. Anthony, Assistant Engineer, 1st grade, Betwa Canal, is transferred to the 1st Circle, Irrigation Works.

Mr. W. B. Gordon, Assistant Engineer, 1st grade, Eastern Jumna Canal, is transferred to the 2nd Circle, Irrigation Works.

Burma, January 15, 1887.

Mr. P. E. Raven, Assistant Engineer, 2nd grade, Amherst Division, reported his return to duty from privilege leave on the afternoon of the 28th December 1886.

Mr. W. Algie, Executive Engineer, 3rd grade, sub. *pro. tem.*, reported his arrival at Rangoon on the forenoon of this date and is posted to the charge of the Pegu Division.

Mr. M. R. Lackersteen, Executive Engineer, 2nd grade, reported his arrival at Rangoon on the forenoon of this date and is posted to the charge of the Arakan Division.

Mr. T. Concannon, Executive Engineer, 4th grade, temporary rank, reported his arrival at Rangoon on the forenoon of the 27th November 1886.

Mr. Concannon's services are placed at the disposal of the Superintendent of Works, Upper Burmah.

Central Provinces, January 20, 1887.

Rao Sahib Ishwari Prasad, B.A., Assistant Engineer, was relieved of his duties in the Nagpur Division, on the forenoon of the 11th idem. Rao Sahib Ishwari Prasad, B.A., Assistant Engineer, reported his arrival at Raipur on the afternoon of the 13th idem.

Bengal, January 26, 1887.

General.

Baboo Krishna Chundra Bandopadhya, Assistant Engineer, 1st grade, is granted three months' leave on medical certificate, in extension of the leave granted to him in Notification No. 279 of the 20th July 1886.

Irrigation.

Mr. T. H. Clowes, Assistant Engineer, 1st grade, attached to the Mahanuddy Division, passed the Lower Standard Examination in Hindustani on the 3rd instant.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department:—

20th January 1887.

134 of 1886.—Henry Hamilton Remfry, Solicitor and Patent Agent, of 5, Fancy Lane, Calcutta.—*For improved substitutes for leather, applicable for driving belts, boot and shoe soles, covering machine rollers, and other uses.*

151 of 1886.—George Gauthier, of Hazaribagh, in the Province of Bengal, Silk Spinner, for new processes, and new applications of existing processes.—*For all descriptions of cocoons in the stifling, disintegrating, boiling, steaming, and reeling into raw silk or tram.*

221 of 1886.—Richard Olpherts, of Ardee, Ireland, Esquire.—*For improvements in the means or apparatus for oxidizing indigo.*

222 of 1886.—Richard Olpherts, of Ardee, Ireland, Esquire.—*For improvements in, or relating to, indigo presses.*

223 of 1886.—Alfred René Upward, Electrical Engineer, of 10, Talgarth Road, West Kensington, and Charles William Pridham, Physician, of 10, Cromwell Crescent West Cromwell Road, both in the County of Middlesex, England.—*For improvements in galvanic batteries and in the application of the same to electric lighting and other uses.*

231 of 1886.—James Milne of the Firm of Milne Brothers of the Town and County of Aberdeen, North Britain, Grain and Produce Merchant.—*For improvements in apparatus for drying malt, grain, seeds, and other analogous vegetable products.*

237 of 1886.—Peter Smith Swan of Calcutta, in the Empire of India, Jute Manufacturer.—*For increasing the efficiency of furnaces used for heating air applicable to that class of furnaces in which the air is heated by contact with surfaces, the other side of which is in contact with the flame or hot gas of the furnace.*

SELECTED ABSTRACTS OF RECENT BRITISH SPECIFICATIONS.

Improvements in Electrical Locking Apparatus for the working of Trains on Double and Single Lines on Railways and for other purposes.—No. 10,952 (1886).—*C. E. Spagnoletti.*

The principal object of this apparatus, which is the invention of the well-known Electrical Engineer to the Great Western Railway Company, is to render it impossible for a signalman on a railway to work a signal for running trains at stations, junctions, or crossings without the co-operation of the signalman at the block station in advance, who is himself controlled by the arrival at or departure of the train from a given point, near his station.

A further object of the invention is to render it impossible for a signalman to work points and signals for certain roads or sidings for shunting purposes, if they conflict with one another, or for a train to leave a station or pass a given signal, if the said signal is not lowered for it.

A complete set of the apparatus for one "block," on a single line of railway, consists of an instrument enclosed in a case and placed in each cabin, to be operated by the signalman, locking mechanism attached to the required signal levers, and a treadle electrical contact disconnector operated by a passing train. For a double line the number of instruments will be increased in proportion.

It would be difficult, without the aid of drawings, to give a detailed description of the construction of the mechanism of the various parts of the apparatus, but some idea of the value of the invention may perhaps be derived from the following explanation of its practical working: Let the stations at the ends of the block be called A and B, and let it be supposed that a train at A requires to pass to B, A's starting signal lever being locked, the signal cannot be lowered, but on A sending a bell signal to B, B, if the line be clear, will depress a plunger in his instrument, which, by completing an electrical circuit, releases, through the action of an electro magnet, A's lever lock and enables his signal to be lowered. The instrument is so constructed that the plunger at B is now automatically locked and cannot again be used to unlock A, until the train has passed the treadle contact breaker at B. This apparatus is not affected directly by the train, but is placed under the rail, and the depression or vibration of the rail under the passage of the train, affects a specially arranged lever, which breaks the circuit previously established by the plunger, and in so doing releases the plunger and enables it again to be used, in the same manner as before. The signal lever is automatically locked by the action of replacing it to danger. Various discs are provided in the instruments and automatically worked in connection with the plungers, treadle contact breaker, and lever locks, and exhibit "train on line," "line clear," "train arrived," "lock on," "lock off," or other required notifications. If the instruments are arranged for "single line" working, they are so constructed, that when B has depressed his plunger, allowing A to send a train to B as just described, he also, by means of the current, locks A's plunger, so that A cannot take off B's lock, and therefore trains cannot enter the same block from opposite directions. In practice, the circuits which are completed, do not directly perform the various operations required, but actuate polarised relays, which close local circuits for the purpose.

When it is required to render it impossible for a train to proceed on the main line, if the driver wilfully passes the signal at danger, facing points are so connected with the signal lever, that the train would in such case be shunted on to a siding.

We understand that this aparatus of Mr. Spagnoletti's, which is really an improvement upon and development of a former patent of his, is already in successful work upon several parts of the Great Western System.

AN APPEAL.

The public and the friends of the late Conductor D. GUNNING, Traffic Manager of the Ganges Canals, are earnestly invited to aid in the formation of a fund for the relief of his widow and four young children left almost destitute. The labour which Mr. Gunning undertook voluntarily for the welfare of the Upper Subordinates of the P. W. D. and Officers on the Unattached List will, it is hoped, be recognised by a ready response to this appeal, for the public have never been asked to contribute to a more deserving and urgent cause. The following gentlemen have kindly consented to acknowledge any subscriptions received by them :—

T. Baker, Ordnance Department, Madras.
E. Cooke, Sub-Engineer, Cawnpore.
H. Ellis, District Engineer, Salem, Madras Presidency.
A. Gilmour, late Editor, "Delhi Gazette," Agra.
A. O'Brian, District Engineer, Unao, Oudh.
T. Tyres, Sub-Engineer, Sunna, near Etah.

Notices.

The Office of Publication of **Indian Engineering** *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

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STRAITS SETTLEMENTS.—"THE STRAITS TIMES," *Singapore.*

CHINA AND JAPAN.—LANE, CRAWFORD & Co., *Hong-Kong, Shanghai,* and *Yokohama.*

JAVA.—G. KOLFF & Co., *Batavia.*

AUSTRALIA.—GORDON & GOTCH, *Melbourne, Sydney,* and *Brisbane.*

MR. E. A. DUKES, late MANAGER of MESSRS. W. NEWMAN & Co., LD., CALCUTTA, is now representing INDIAN ENGINEERING in the Upper Provinces.

OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Answers to Correspondents.

SEVERAL Contributions are held over for want of space.

INDIAN ENGINEERING.

SATURDAY, FEBRUARY 5, 1887.

INDIAN RAILWAYS.

THE Bombay, Baroda and Central India Railway Company are to be congratulated on the result of the half-year ended 30th June 1886. After paying Government £240,000 (the surplus profits over 5 per cent.), the income tax for 1886, and a dividend of £4-3-6, the Directors carried forward to the account of the next half-year £5,000. From the data before them hopes were entertained by the Directors of realising for 1886 a dividend of £7-2 per cent. against of £6-17-6 in 1885. The surplus receipts of this line have steadily increased from £210,000 in 1883 to £312,000 in 1886—closed to 30th June. The working of the Rajpootana-Malwa Railway managed by this Company shews Rs. 31,40,000 as the surplus earning for the half-year under notice, which enabled the Directors to pay Government Rs. 25,12,000 and declare a dividend of about 12*s.* 6*d.* per cent. on the stock. The prospects of the Cawnpore-Achnera Railway, also managed by this Company, appear favorable. In order to meet the necessities of increased traffic on these lines, it is intended to extend the Godra Branch to Rutlam on the Rajpootana Railway. The proposed organisation of a company, affiliated in its management to, but in other respects independent of, the B. B. and C. I. R., to extend the line from a point near Ajmere to Umballa and Khalka, deserves the serious consideration of the Indian Government to whom the scheme has already been submitted. With the extension of this line and the Godra Branch and other tributary lines a good future may be predicted for this Company. The Rajpootana-Malwa line is a curse to the broad gauge systems of Railways and should, we think, be at once converted to the broad gauge, whose advantages are too well known and generally recognised to require dilation at our hands. The narrow gauge is a mistake in a country like India, except for purely feeder lines.

The report of the working of the East Indian Railway for the half-year closed to the 30th June 1886, shows considerable improvement in the traffic returns and realization of profits. The gross revenue amounted to £2,307,576, against £2,275,406 or an increase of £32,350, and the earnings figured £1,514,019 or an increase of £4,297. The working expenses compare rather unfavorably with those of the previous half-year, being represented by £793,737 or an increase of £28,053, due partly to the construction of the Hooghly Bridge which is now a *fait accompli.* The Directors of this Company declared a dividend of £1-4-6 per cent. on the deferred annuity capital—after meeting the guaranteed interest of 2 per cent. and the income tax of Rs. 28,282—and carried forward a small balance. This is a very satisfactory result, seeing that the loss in exchange alone amounted to no less than 25 per cent. of the net earnings.

Notwithstanding the many drawbacks and disadvantages arising from the fall in the value of silver, incidence of income tax, and the comparative smallness

of the down traffic, the Directors of the Great Indian Peninsula Railway, have been able to pay a dividend of £1-4 per cent. in addition to the guaranteed interest of 2½ per cent. for the half year ending 30th June 1886. The shareholders must be congratulated on the result achieved, as it shows a decided improvement on the past. Wheat, linseed and salt are the great staples of this Railway; and while there appears a substantial increase under the heading of the first article, there is a noticeable falling off in the last two. There is also an improvement in the cotton traffic. Of the total quantity of wheat exported from Bombay to Europe and elsewhere 78 per cent. was brought down by this Railway.

The gross earnings—highest on record—of the South Indian Railway Company for the same period of last year are returned at £233,374, showing an increase of £12,747, and the expenses which aggregated £155,724 or £17,006, more than the previous half-year, rose from, £62·87 to £66·72 per cent. This increase is ascribed to renewals of permanent way with heavier rails than originally laid and expenses involved in repairing breaches caused by flood. The earnings are progressive, the profit of the half-year amounting to £3·49 per cent. per annum on the total capital raised.

There is nothing of importance noticeable in the report—second half-yearly—of the Indian Midland Railway, except the progress of construction. Forty-one miles have already been opened and 95 miles will, it is hoped, be opened by the end of 1887. The completion of this line will prove of great benefit to the G. I. P. R.

The Report of the Directors of the Bengal and North-West Railway Company, read at the half-yearly general meeting is important as showing the ways and means in contemplation and adopted to render this Company's affairs prosperous in the far future. For instance, we are told that the lines now in course of construction and extensions in contemplation are estimated to cost £2,062,000; that additional engines and wagons are called into requisition in consequence of the rapid expansion of traffic; that arrangements are in progress with the Oude and Rohilkund Railway for improved traffic facilities; and that E. I. R. have come forward to co-operate with them for the development of traffic. This is progress in the right direction. The earnings of the first half-year of 1886 showed Rs. 8,80,000 and the expenses amounted to Rs. 5,00,000, resulting in a profit of Rs. 3,80,000 or £27,740 at the exchange of the time. The profits, actual and estimated, however, fall short of the guaranteed 4 per cent. interest by £6,000. There is a material increase in goods and passenger traffic. There will be a call of 10 shillings per share to meet the demands of works in progress and contemplated, to likewise meet the cost of the additional rolling-stock and other requirements.

ENGINEERS' WALL DIAGRAMS.

An exceedingly ingenious mode of making large wall diagrams for the illustration of scientific or other papers has just been devised by Mr. J. P. Maginnis, of London, lately head draughtsman to the Institution of Mechanical Engineers. By this method the most complicated drawing can be reproduced on a scale enlarged to any extent in an incredibly short space of time.

The facility with which it is done affords an opportunity not hitherto obtained for giving views in perspective, on a diagram scale, of the machine or object it is desired to illustrate. The mode employed is simple and free from complication of any sort. It is to a certain extent similar to that used by the French when Paris was besieged by the Germans, for spreading the news they received from time to time by means of carrier-pigeons. It will be remembered that confederates, say in London, photographed sheet by sheet of the *Times* or any other journal upon collodion tissue, reducing the size of the pages in the process to about four square inches each. A dozen or two of such miniature sheets did not weigh more than a pigeon could comfortably carry. If the bird reached Paris, and was caught and its load obtained, the tissues were stuck down upon glass, placed in a magic lantern, with lime light behind, and then projected on a screen, being highly magnified in the process. Any number of newspaper reporters had then an opportunity of transcribing from the screen the news of the day. The general idea of Mr. Maginnis's method may be gathered from this description; but, of course, to carry it out in detail many other points have to be observed which experience has taught. It is obvious that the same methods may be applied with advantage to making large maps from small ones, or to the production of panoramas, or stage scenery.

THE MADRAS HARBOUR DESIGN.

We have been favoured with a copy of a lecture delivered by Mr. Parkes, Engineer-in-Chief of the Madras Harbour, in Madras some half dozen years back, which purports to elucidate the principles that dictated the general design adopted by that gentleman to meet the case of "a dreary line of sandy beach beaten by never ceasing surf." We have no desire to attack Mr. Parkes or his work, but would prefer to obtain information and give hints for future works. At the same time, however, as we happen to have the lecture before us, we may observe that the only reason that Mr. Parkes gives for not adopting a sloping sea face is that he thinks there would be a greater cost in stone. This begs the question, for he does not attempt to prove that with equal durability, the sectional area in his design is a minimum.

If science in building demands a reasonable economy in material and a study of *form* as giving strength, why should not similar principles apply to breakwaters?

As we hope to describe and discuss the Madras Harbour at length in future issues, further comment on the subject is unnecessary.

The much-spoken-of project of a direct telegraph connection between Peking, and consequently that most important trade centre of China, on one side, and Europe on the other side, which was to be set on foot by the Marquis Tseng, seems about to take a practical shape. At least it is reported to us from Tientsin that plans prepared by competent parties have been accepted with great eagerness by the Imperial Government in Peking; and it is reported in Shanghai that the carrying out of this project will be one of the first aims which will occupy the time of the Marquis Tseng during his stay in Peking.

Notes and Comments.

CHIEF ENGINEER, P. W. D., BENGAL.—It is uncertain who will be offered the Bengal appointment when Colonel Trevor retires. Mr. Horace Bell and Mr. F. L. O'Callaghan are well in the running, but the latter gentleman will probably remain attached to the Government of India in the Railway Branch.

BENGAL RAILWAYS.—The proposed amalgamation of the Eastern Bengal and Northern Bengal State Railways will come into force on the 1st April next. We have not yet heard by what name the new system will be called; the Bengal Railway would be as appropriate as any. Major Boughey, R.E., undertakes the management oft he amalgamated line, and Major Savi, R.E., the present Manager of the N. B. S Railway, takes furlough.

A SEVERE AND UNFAIR IMPOST.—A heavy duty on *teak* imported into Lower Burmah *viâ* the Irrawady is to be levied, unless the timber has been extracted from a forest where a royalty is paid. For logs 18 feet long and over and above 4 feet 6 inches in girth the duty has been fixed at Rs. 10 per ton, and for logs of smaller dimensions Rs. 7-8 per ton. We recently noticed that an order had been issued directing P. W. D. Officers to purchase *teak* from the Bombay-Burmah Trading Co. and none else, and as we believe that that Company has negotiated a royalty on Upper Burmah timber, it is hardly possible that many competing firms will continue business.

RICE MILLS.—The almost total absence of Rice Mills in such rice producing countries as Bengal and other deltaic areas of India is as often a matter of surprise as regret to many. Our friends in Burmah are disposed to be amused at the advertisement in this and other journals over the signature of a well-known Bombay firm, offering a Rice Mill at Port Canning for sale or lease. This mill is described as *the largest in Asia*, being capable of turning out daily 1,000 bags of cargo, or 800 bags of white rice daily. But we are informed that there are probably in Burmah, at the present moment, at least twenty Rice Mills of greater capacity. In Rangoon there are two which could easily turn out treble the number of bags in the 24 hours.

MYSORE RAILWAY.—Things are very dull on the Mysore Extension of the S. M. line; Government will not sanction the revised estimates and consequently a great number of the Engineering staff are doing nothing. The Mysore State had cut down their earthworks to the very narrowest limits. On the open line traffic has to be stopped or speed considerably reduced during heavy rain. The Superintending Engineer wants to increase formation width of all new banks and raise them in several places, but apparently Government inclines to keep to the old estimate and there lies the hitch. The Chief and Superintending Engineers estimate that they will have the line open for through traffic within eighteen months from date of starting construction. As far as we can learn, there is only one very important work on the 168 miles to be constructed and that is the bridge over the Tungabadhra River at Harihar on the Northern frontier.

STEAM LAUNDRIES IN THE EAST.—A Straits paper observes that it is an open question whether any Steam Laundry ever started in the East has proved a success. Years ago that of Calcutta,after various vicissitudes,came to grief. A year or two ago one was set a-going in Rangoon; it lived a few months and now any enterprising individual can buy the plant for a song. There are plenty of enterprising men in Burmah, but they will have nothing to do with this scheme. To these failures may be added those of Singapore and Hong-Kong. It is not difficult to discover the cause of default; each of these Companies was started with a view to ousting the *dhoby* or washerman and to do better work. Experience has shown that the steam laundries possessed a happy faculty of destroying clothes much faster than the native *dhoby*; delivery was on the whole not so punctual; the washing was not done better and the cost was higher. To this must be added the opposition of the *dhobies* who, of course, refused to work in them.

THE GOA RAILWAY.—This line, which was opened for traffic on the 22nd January last, is 51 miles long. Compared with the neighbouring lines, it is of a difficult character, for, though on either side of the town of Marmagao the line is an easy one, yet within these twelve miles there are four important and expensive bridges. Including the large reclamation behind the quay at Marmagao, which in itself costs four lakhs, the first 38 miles of the line can be taken as costing a little over $1\frac{1}{2}$ lakhs per mile, including its due proportion of locomotives and rolling-stock. The thirteen miles of Ghat, which is expected to be open before next year, will have cost no less than six lakhs per mile. This ghat is said to be in no way inferior as to quantities, and as to cost of labour and material exceeds considerably that of the Bhore Ghat of the G. I. P. Railway, the cost of which was more than this amount per mile to formation only, without reckoning permanent way, locomotives, rolling-stock and supervision. The harbour will cost about 26 lakhs only, and is said to be very cheap at the price. This will give a grand total, when the line and the harbour are completed, of 175 lakhs.

MR. E. J. MARTIN, M.I.C.E., F.R.I.B.A., SUPERINTENDING ENGINEER, P. W. D., BENGAL.—We hear, on good authority, that Mr. E. J. Martin, Architect to the Government of Bengal, has definitely decided not to return to Bengal until next cold weather, on account of the unsatisfactory state of his health. This is much to be regretted, as Mr. Martin would, in all probability, have been appointed Chief Engineer and Secretary to the Government of Bengal, in the place of Colonel S. T. Trevor, R. E., who goes home, we hear, in April. The appointment would have been most appropriate, as Mr. Martin has considerable Railway experience, and his ability as an architect is known to all. He is, therefore, pre-eminently fitted for such a position as that of the Chief Engineership of Bengal, which administers all the Railway and Provincial Public Works belonging to the Province. It is uncertain whether Colonel Trevor will return to this country or not, but his departure will be regretted by all who have had the pleasure of serving under him. The large public works carried out during his time, and the agreeable remembrance of the first great Exhibition ever held in India, will serve to keep him in the memory of the Profession for years to come.

"EXCHANGE" AND "PENSION" QUESTIONS.—The rate of payment for pension and furlough allowances for this year has been fixed by the Secretary of State at 1s. 6*d.* to the rupee. In view of the rising tendency of the market, this may seem hard to many who are going home, but there is balm in Gilead! The Finance Committee appear to have grasped the fact that the Civil Engineers of the

Public Works Department do not take their pensions, but prefer to die in harness rather than retire on incomes which may amount to any unknown quantity, according to the variation of the rupee between the values of 1*s*. 3*d*. and 2*s*. It is believed the Committee have decided to recommend to the Secretary of State that a minimum rate be fixed for the payment of pensions. What that minimum rate is, remains to be seen; but it is to be hoped that it will be fixed in a generous spirit, so as to put an end to the now existing agitation for sterling pensions. A little liberality in the present juncture will be economy in the end. Another consideration is, that if a fair minimum value be settled upon, a certain number of retirements may be shortly expected in the P. W. D., which would result in a moderate, but much to be desired flow of promotion. At present the Department is in a state of congestion.

Muir College, Allahabad.—The opening ceremony of this most important building, which was presided over by His Excellency the Viceroy, took place on the 8th April 1886, in presence of a large assemblage. The foundation stone was laid by Lord Northbrook in December 1873, so that the entire work has occupied 12 years 4 months in its execution. The building, constructed from the design of Mr. R. Emerson, C.E., the well-known architect, has cost up to the date of its opening Rs. 6,80,000. Its execution has been throughout in the hands of Mr. Heinig, Provincial Executive Engineer of Allahabad, who has carried on the work in addition to his regular duties, and full effect has been given to the architectural features of Mr. Emerson's striking and effective design. But Mr. F. S. Growse, whose efforts have been directed for many years past to an attempt to rescue the indigenous arts of India from the demoralizing and destructive influence of the Public Works Department, is confident that if the work had been entrusted to a guild of native architects, they would have risen to the occasion; a powerful stimulus would have been given to local talent; the cost would have been largely reduced, and most of the incongruities of treatment would have been avoided!

Kurrachee Harbour Improvements.—The new wharf of which the first pile was screwed in the presence of Lord Reay on the 18th January last and named the "Erskine Wharf," forms the beginning of the line of the Napier Mole Wharfage proposed to be extended from the northside of the "Merewether" Pier at Keamari, to the south end of the Napier Mole Bridge, comprising a length of 6,400 feet or nearly 1¼ mile of ship wharfage and 680 feet of boat wharfage at the upper end, which last is now nearly completed. The funds for the wharfage works now in hand, including the boat wharf, are being provided by a loan of 10½ lakhs of rupees, of which about 2¾ lakhs were raised in the Indian market at 5 per cent., and the balance has been lent by the Government of India, at 4½ per cent., repayable in thirty years on the guarantee of the Government of Bombay. In addition to this, a loan of 5 lakhs of rupees has been granted by the Government of India on similar terms for provision of additional dredging appliances (especially for deepening of the entrance) for moorings and sheds. A grant of 3½ lakhs of rupees has also been given by the Government of India for the removal of the rocky shoal called "Deep Water Point" and for the curved extension of the East Groyne, works which are required to perfect the original project for general improvement of the harbour.

Current News.

The Farewell Dinner to Colonel W. S. Trevor, V.C., R.E., by the Members of the Profession, will take place at the Dalhousie Institute, Calcutta, on Tuesday, the 15th instant.

The steam flour mills which were lately started at Lucknow promise to be a decided success.

Mr. Bradford Leslie, Agent of the East India Railway, goes on leave to England in April next.

An Exhibition of English and American Agricultural Machinery was held at Shikarpur, Sind, on the 29th January last.

Captain Burn Murdoch, R.E., Acting Deputy Consulting Engineer for Railways, Bombay, reverts to the Military Department.

Honorary-Captain and Deputy Commissary Joseph Edmundson, Public Works Department, is transferred to the pension establishment.

Work on the Etawah Division, and the Baroda-Lalitpur Sections of the Indian Midland Railway is to be commenced immediately.

The Quetta Railway has reached the very foot of the Khojak Amran range. The first engine ran into Gulistan Karez on the 22nd instant.

Mr. E. E. Oliver, Under Secretary to the Panjab Government in the Public Works Department, has returned from furlough, and taken over charge from Mr. Ivens.

The *Railway Service Gazette* states that the Government have finally decided that the offices of the Director-General of State Railways shall be located permanently at Allahabad.

The Secretary of State has sanctioned the estimate, amounting to Rs. 27,22,940, of the cost of constructing an extension of the Sind-Pishin State Railway from Quetta to the Kotal at the top of the Bolan Pass.

The Government of India has sanctioned a contribution of Rs. 55,000, from Imperial revenues, towards the cost of constructing the Murree-Kohala road, the Panjab Government spending Rs. 80,000 on the work.

According to a London telegram to the *Pioneer*, the Bengal-Nagpore Railway scheme has been arranged between a syndicate and the Secretary of State. The company obtains the same terms as the Indian Midland Railway.

General Hancock has been appointed to succeed Colonel Trevor as Secretary in the Public Works Department, and Colonel Pemberton (Consulting Engineer for Railways at Lucknow) to be Director-General of Railways, *vice* General Hancock.

It is said that the question of transferring the Kidderpore Dock Works to the Public Works Department has not yet been decided. The services of Mr. Apjohn have been placed at the disposal of the Port Trust as prospective Chief Engineer.

The length of the Cuddapah-Nellore State Railway is only about 80 miles. The work has been going on for the last four years, and is as yet not completed. The public are disgusted at the delay. The Tirupaty Division alone shows good progress.

The proposal to appoint an Assistant Controller of East Indian Railway Stores, which was approved of by the Board of Directors, has been negatived by the Government of India, the opinion being that such an appointment, costing about Rs. 9,000 a year, does not appear necessary.

Most people will agree in the discerning judgment of Sir M. E. Grant when he praises the work of Colonel Jacob, of Jeypore, and many will feel surprised that, when Whitehall clerks and "carpet knights" have been honoured, a man like Colonel Jacob has been forgotten.

It is notified that ten appointments to the Indian Forest Department will be vacant in June next, to be filled by the selection of the Secretary of State from among the competitors successful at a qualifying examination. The selected candidates will proceed for a course of training to Coopers' Hill.

Upon the recommendation of the Consulting Engineer of the Madras Railway Company, Sir John Hawkshawe, it has been definitely decided that the piers of the Kullai bridge on the Calicut Extension shall rest on rock, said to be met with only nine feet below the 36 feet depth, to which a cast iron cylinder, 9 feet in diameter, has already been sunk.

The Southern Mahratta Railway has been opened for public traffic between Dharwar and Deoli on the Portuguese frontier on Tuesday. Two passenger trains now run daily to and from Marmagola in connexion with the West of India Portuguese Railway, the short length of ghats alone intervening. The Bombay Steam Navigation steamers run in connexion with these trains.

The subordinates of the Tank Maintenance Division of the Public Works Departments, Madras, have received a month's notice, at the end of which period their services will be dispensed with. Those who are willing to proceed to Burmah, the Government are prepared to provide for. We understand that about eight hundred hands will be thrown out of employ through the abolition of this department.

The P. W. D. is hard at work on roads and other works at Mandalay. Among these the Jail and the widening of the Shoay-ta-Choung Canal may be considered the most important. The latter will bring a regular supply of good drinking water to the inhabitants of Mandalay from the Madea River, and

it is being widened and deepened to admit of large boats and steam launches passing up and down it.

THE *World* says:—India is losing a good man in General H. A. Brownlow, R.E., who since the year 1882 has held the important post of Inspector-General of Irrigation. He has nearly forty years' service, and was actively engaged during the Mutiny, being all but mortally wounded at the siege of Delhi. He had an almost narrower escape six years afterwards from a wounded tiger, from whose claws he was saved by another distinguished sapper, now Sir Oliver St. John. A pleasant kindly man, he will be greatly missed.

AT the Ordinary Annual Meeting of the Asiatic Society of Bengal, held on Wednesday, the 2nd instant, the following papers were read:—1. On the observed changes in the density of the surface Sea water, coincident with, and due to, Aerial disturbances, and consequent alternation of baric pressure over adjacent sea areas—By S. R. Elson. 2. On the influence of Indian Forests on the rainfall—By H. F. Blanford, F.R.S., Meteorological Reporter to the Government of India.

THE Lahore Cathedral, the consecration of which recently took place, has cost a little over four lakhs. The towers and interior decorations have, however, yet to be finished, and a peal of bells and a new organ are contemplated. The original estimate for everything was six lakhs. The Cathedral building is handsome and imposing, and a great acquisition to Lahore. The foundation-stone was laid in February 1874. We hope to produce the Drawings and Description in an early issue.

ALTHOUGH considerable doubts were at first thrown on the discovery of kaolin or china clay at Whitefield in the Madras Presidency, all doubt is now dispelled. Messrs. Arbuthnot & Co., have taken a lease of the property, having entered into a contract with the Telegraph Department for the supply of insulators. They have also engaged a trained potter from Bombay, who has already begun operations. It has been decided to remove the works from Whitefield to Avady, which is within easy reach of Madras and has a good water supply. The necessary machinery and plant have been ordered from England.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

NATIVE CUTLERY.

SIR,—I have received from a native cutler of Burdwan, by name Gour Chand Dey, two specimen pen-knives of his manufacture. The steel is of excellent quality, and the style and finish leave nothing to be desired.

In my opinion they are fully equal to the majority of English-made knives imported into this country, and infinitely superior to the German cutlery now, unfortunately, becoming so common here. The maker appears to have modelled his work upon that of Messrs. Joseph Rodgers and Sons, of Norfolk St. Works, Sheffield, and if, like this well-known firm, he will only conscientiously turn out a thoroughly good article, he may be sure of support, in spite of foreign competition. It speaks well for Indian enterprise and skill that such work can be accomplished in these days of cheap and inferior goods.

ALFRED H. HANSON STILES,
Manager in Calcutta to James Crowder,
Sole Representative in India for Joseph Rogers and Sons, "Limited.'

MINERAL DEVELOPMENT.

SIR,—I have been pretty nearly all over the world, but it has never been my misfortune to see a country so neglected, backward, and ill-developed as India. It is positively sickening and heart-breaking to anyone who has been elsewhere. Trying to move the Government is an uphill task. I might point to the action of the Government with the Burma ruby mines where they have not much troubled themselves about finicking enquiries as to ownership,* which I have found the great stumbling-block here, although, as far as the wasteness of the land goes, there's not one jot to choose between here and Burma. It is no exaggeration to say that, from here south-eastwards to Katák, and from Balasor westwards to goodness knows where, it is one howling jungle, to be allowed to FREELY prospect through which would harm no man to the extent of a pice, *but, on the contrary, might very probably lead to discoveries undreamt of in the philosophy of the delightfully go-ahead Government that we are blessed with in this sleepy-headed country—which discoveries would mean profit to the country at large.* The action of the Indian Government is the blindest and most wrong-headed that it is possible to conceive. For the sake of very problematical at (all events, *useless*) ownership, life and wealth, and progress and civilisation are to be stifled and cramped.

I hope to see, in an early issue of INDIAN ENGINEERING, a downright sledge hammer article on the subject.

YUBA BILL.

CHYBASSA: *January* 20, 1887.

* Recent intelligence from Burma would appear to contradict this.—ED., *I. E.*

Notes and Queries.

N. B. ROY (Debree) writes:—Would some of the readers of your valuable paper kindly oblige me by answering following questions:—

1. What are the relative advantages and disadvantages of burning bricks in clamps and kilns?
2. What objections are there to the use of arsenic as a material in painting—except its being poisonous?
3. What article (except Rectified Spirit) mixed with cocoanut oil, ghee (clarified butter), etc., would keep them in a constant liquid state even in the frigid zone?

Literary Notices.

AN INDIAN MICROCOSM. *By "Observer."* Allahabad: The Pioneer Press. 1886.

THIS neatly got up Pamphlet comprises about a dozen or more short sketches of Anglo Indian Society or the Social elements that make up the life of a small Indian Station. It is written by an Executive Engineer, and the topics comprise the usual occupants of centres of administration in the Mofussil, official and non-official. These representative characters are portrayed with a detail and vigor that convey a true general idea of so-called up-country life, while at the same time the descriptions are as easy and agreeable as it is possible for such writings to be.

Among the residents of the "Station," the "DISTRICT ENGINEER," of course, affords food for a subject, and the concluding paragraph of the Sketch under this head, will bear reproduction:—

Our District Engineer seems to have no boss at all, except the Collector, or that shadowy body, the District Board. He declaims with energy against the idea of his being in any way subordinate to the Divisional Executive Engineer: they do come in contact somehow, but, like opposite poles, there is no sympathy; on the contrary, very strong antipathy, which sometimes leads to wordy warfare. Our Collector backs up the professional opinion of his District Engineer; and the Commissioner, that of his Executive Engineer: of course, the weaker vessel must eventually give in, but the internecine strife is not closed without some good hard blows being given. The ways of the P. W. D. are inscrutable. Why is so absurd, expensive, and useless an anomaly as we have been describing, tolerated for a moment? Red tape—nothing but red tape. It can't go on for ever. The old P. W. D. is doomed in our time. We shall probably see the old battered ship founder, stern foremost, in the waves of a financial investigation. The last we shall see of her will be the red tape pennon flying at her mizen.

RULES FOR CALCULATING THE VELOCITY AND DISCHARGE OF RIVERS AND OPEN CANALS. *By Rai Bahadur Kunhya Lall, M. Inst. C. E.* Lahore: The New Imperial Press. 1886.

ORIGINALLY compiled as a Class-book or Manual for Students and two editions having been exhausted, the author of this well-known Manual has been induced to prepare another edition under the hope that it will prove more *generally* useful than its two predecessors. The end and aim of the book is to bring within a small compass all that is really requisite to attain a fair knowledge of the subject of Practical Hydraulics. The Tables have been tested by experience, and give unusual facility for the solution of questions of every day occurrence in Engineering practice. Although we see nothing in the book on the new formulæ of D'Arcy, Kutter, and Bazin, the applications of which are enshrouded in doubt, still we have something more useful in Dicken's short and simple formula for finding the Discharges of Rivers, which is now embodied in the book for the first time.

MADRAS JOURNAL OF EDUCATION AND SUPPLEMENT. New series. January 1887.

THIS Magazine is the revival of a well-known journal which ceased to exist some five years back, and its re-appearance in a new form should be welcomed by all interested in educational matters in India. In the present issue we notice a valuable contribution on "Commercial Education" with some observations on Technical Education. The SUPPLEMENT is chiefly devoted to the Examination Papers set at the University and other competitions in Southern India.

General Articles.

RANGOON DRAINAGE PROJECT.

SHONE'S HYDRO-PNEUMATIC SYSTEM.

(Continued from last issue.)

In order to be on the safe side, we should base our estimates for determining the sizes of the engines, compressors, and boilers, on the following data :—(1) We should assume the ultimate population to be provided for to be 41,468 ; (2) the sewage discharges to be equal to 30 gallons per head per day ; and (3) we should calculate the horse-power on the assumption that the whole of the sewage would have to be lifted to the greatest height given in our table on page 12, *viz.*, 62 feet.

The maximum quantity which we should have to eject every minute under these circumstances has been estimated to be =1,546 gallons. The horse-power in net weight of water lifted would therefore be $= \frac{1,546 \times 10 \times 62}{33,000} =$ 29·5 horse-power. If you carried out this project, you would require an engine which should indicate about 60 horse power in the steam cylinders.

The engines, compressors, and boilers, shown in Drawing No. 7, you will observe are in duplicate, and each will be capable of developing greater power than that stated, so as to provide for any possible increase in the sewage discharges beyond that calculated for. Finding, however, that you have it in contemplation to supplement your present water supply with a high pressure service, we strongly advise you to carry out these contemplated additional works in conjunction with the proposed sewerage works.

Believing that you will entertain this suggestion when it is explained to and clearly understood by you, we beg now to describe the way in which we suggest that the supplementary high-pressure water supply should be carried out. (1) The present water supply should be filtered, as already proposed by you. The filtering reservoir to be situated where shown on Drawing No. 1. (2) The filtered water should pass by gravitation into three large Pneumatic Ejectors, each of 2,000 gallons capacity; these Ejectors to be fixed in a Pneumatic Ejector Station, shown in Drawing No. 6, to be erected upon land close to the filtering beds.

The same machinery that would compress the air for ejecting the sewage would compress air to eject the water supply. All we should want to do in addition to what is necessary for the efficient working of the sewerage project, and what is necessary for this, in the shape of engines, compressors, boilers, and buildings is shown on Drawing No. 7, would be to enlarge the buildings already designed, so that a third compressor and boiler could be fixed and erected within them, and also to lay down air-mains from the one air-compressing station to the water supply Ejector Station, and lay down a water delivery main from the proposed water supply Ejectors to the existing delivery main.

By this arrangement you would be able to connect the high-pressure water service with your present water supply system of piping. These pipe connections are also shown on the Drawing No. 1. The effect of putting pneumatic pressure equal to 62 feet of water head on the water supply Ejectors would be equivalent to your having the filtered water drawn from a reservoir 175 feet above datum, which we believe would be considered a great boon by all the consumers, and especially by those whose properties are furthest away from the present reservoir supply. If this plan be not adopted, then you would have to erect at the filtering reservoir a separate pumping station, with all the attendant cost of such an establishment, which would be considerable ; whereas, by our project, the cost of attendance consequent upon your running two separate pumping stations would be altogether dispensed with.

Rangoon is likely to grow apace, and if so, the Shone System of sewerage will sooner or later be extended to the entire city, a work by the way which can be readily accomplished from year to year as the town grows. Under these cicumstances we have deemed it prudent to provide engines, compressors, boilers, &c., capable of operating the sewage discharges of a much larger population than that given in the table on page 12, *viz.*, 41,648. For the present, however, Mr. Clark is of opinion that provision should be made to eject 1,546 gallons of sewage (see table, page 12), and 2,000 gallons of water per minute, or a total of 3,546 gallons. One of the engines shown in Drawing No. 7 running at 300 feet piston speed will eject to the required height of 62 feet a quantity equal to 30 per cent. in excess of the 1,546 gallons of sewage provided for as the total discharges of the population of 41,468. But the engine could be made to run with ease at 500 feet piston speed, which would result in your being able to eject 3,300 gallons, about 62 feet in height. By adding a third engine of the same power as each of the two already provided for, keeping one as a lie-by, you would, by working two of them together, be able to eject 4,000 gallons per minute when they were running at a piston speed of 300 feet per minute to a height of 62 feet, and this would be largely in excess of the sewage and water supply when united for the purpose of our projects (1) and (2). We beg to observe that in England the sewerage works consist simply in laying down public gravitating sewers in the streets to enable householders to make connections with them at their own expense. Our project for Rangoon, however, not only consists in what is being done in England in the way of providing householders with a sewer into which they can discharge their sewage, but it also includes works of a special kind, and which consist in providing iron trays for the discharge of the sulliage waters, as shown in plan and section on Drawing No 2, and night-soil depots, as shown in plan on Drawing No 2, and in section on Drawing No. 4.

Our estimate for the sewerage project amounts in the aggregate to £170,346. A detailed statement showing how this estimate is arrived at is given in Appendix D. Our estimate for the sewerage and water supply projects together amounts to £187,035.

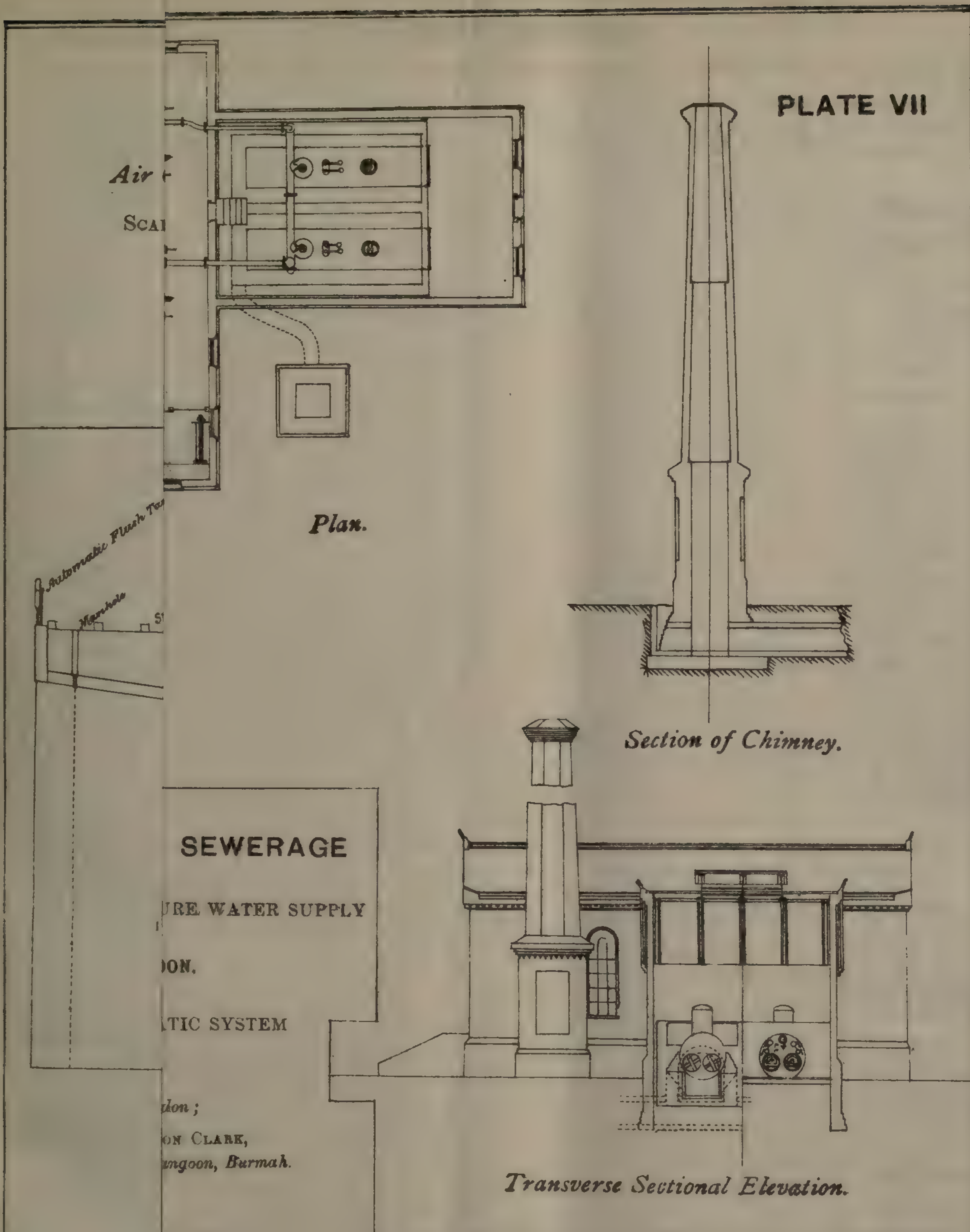
The works of sewerage and water supply comprehend the finding and fixing every kind of material in its place so as to carry out the project as explained in this Report and delineated upon the drawings in a first-class style ready for working.

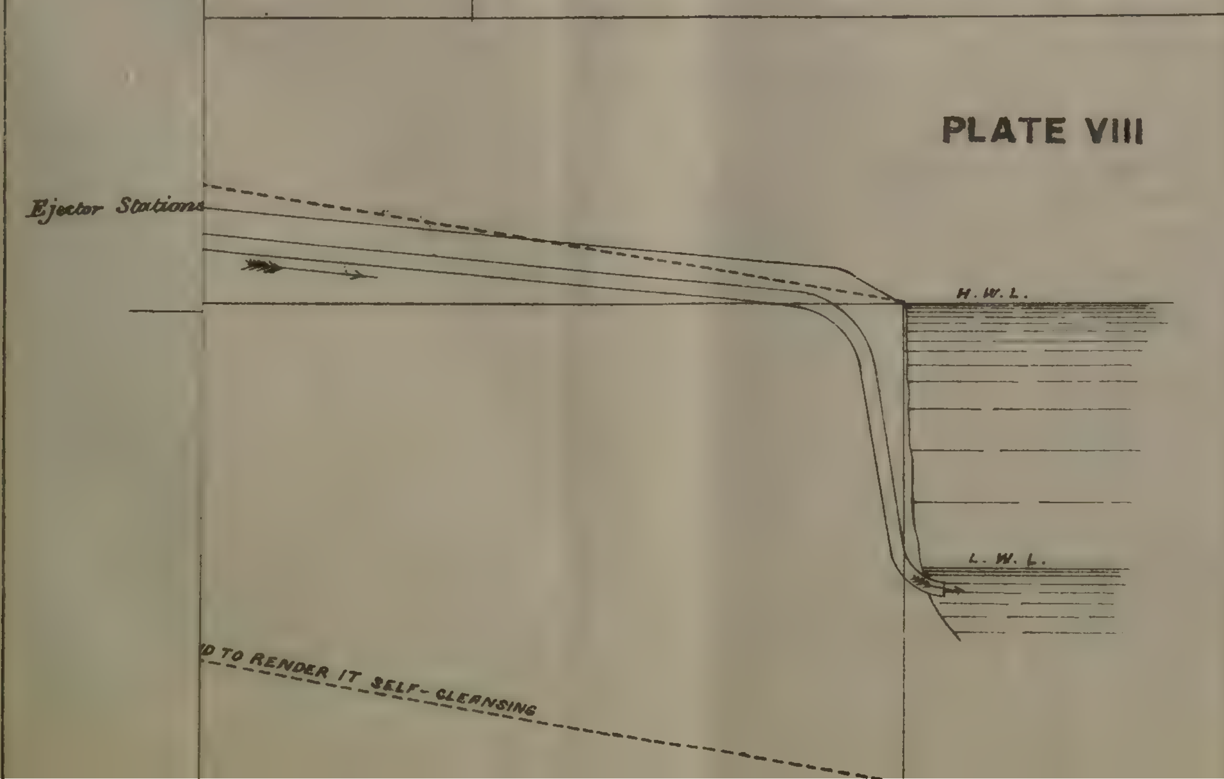
The annual cost of operating the sewerage project, at Rangoon, working for 14 hours per day, would not exceed in practice £1,200 all told.

If the water supply be added to the sewerage project, the expense will be increased to £1,930 per annum about.

We may add that the first cost of establishing an independent pumping station for the water supply would be about the same as the first cost of establishing that station in connection with our sewerage project, but the extra cost of operating an independent water supply pumping station capitalised would amount to about £10,000, so that by connecting this water supply project to the sewerage project this latter sum of money, in round numbers, would be saved. Again, by coupling the water supply project to the sewerage project you could in case of fire increase the pneumatic pressure to almost any desired extent.

We may summarise the advantages derivable from the adoption of our projects 1 and 2, as recommended in the foregoing Report, thus:—(1) You would have machinery and power enough to deal successfully, sanitarily, and economically, with the sewage of that portion of Rangoon which we have called the town proper; (2) the same machinery will suffice when the Shone System is extended to the outlying portions of the town, such as Poozoondoung and Monkey Point on the east, and Kemendine on the west, and, if thought practicable hereafter, the sewage may be ejected on to land for utilisation instead of ejecting it into the Rangoon River; (3) when extensions of the system outside the limits of the town proper were decided upon, you would then simply sink





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as many Pneumatic Ejector Stations as may be found to be necessary from time to time, and connect with them gravitating sewers, air-pipes, and sewage-mains. Every additional station would cause the engines to run a little faster, that is all; but the capacity of the three engines proposed, if erected, would be so greatly in excess of the power estimated for the ultimate population of the whole city of Rangoon, both as regards sewage and water supply, that the extra draught which would be made from time to time upon the resources of those engines would be practically imperceptible for some years to come.

(To be continued.)

RYLES' METHOD OF PAINTING & VARNISHING.

This system is principally intended for carriages or other vehicles—particularly railway stock. The manner in which it is performed is to clean off the old loose paint (if repair work) or if new, put the carriage or other vehicle into a suitable stove, and heat it up from 180° to 280° Fahrenheit, more or less. This expels all moisture, but will not warp or twist the material in any way to cause injury to it. The vehicle is then kept in the stove for six hours, and any blisters, &c., flattened and puttied up as usual and the first coat put on. The vehicle is replaced in the stove, kept there for eight hours, and heated up from 180° to 280° Fahrenheit. This coat, as it forms the ground, should be put on a little thicker than ordinary, as the heat sends it well into the pores of the wood or metal. Each coat after this is worked up in the usual way, and as many coats may be added as are considered sufficient.

By painting in this manner it will be found that less paint will be used and a less number of coats required, on account of the paint being baked hard, which prevents, in a great measure, the usual waste in rubbing down, and gives more body in each coat. Each coat is flattened by pumice or other suitable means—except the last coat but one, when, if a polished surface is required half varnish and half paint should be used—flattening with pounded pumice (very fine) and oil, using flannel or any other suitable material. Boiled linseed oil may be used with all colors. For the last coat copal or other suitable varnish may be used according to the class of work required. One coat, as a rule, will be found sufficient, if not, it should be flattened lightly and re-stoved, and then worked up to the required polish with rotten stone or other polishing substance.

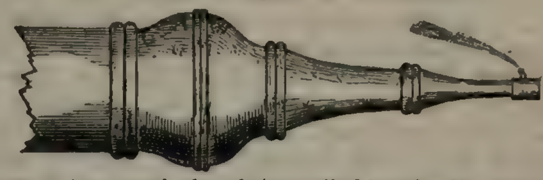
Every coat of paint and varnish should have six hours in the stove at a heat of 180° Fahrenheit (except the first as stated). The above applies to internal as well as external work, and where varnish only is required on wood, panels, &c., to save material it is necessary to first use a filling, of which there are various kinds; and this is well rubbed into the wood. The filling, on the internal parts of the vehicle, should be put on while the external work is being done, so as to keep pace with inside and outside. For ordinary work it will be found that the gloss left on the work after one coat of varnish is good enough for any ordinary first-class carriage, but where a polish like glass is required, (and it can very easily be attaind,) two coats or more ought to be given. Of course only work of a very high class would require such a finish, and that as a rule would be internal finish. When done, the result, as regards appearance, durability, and cheapness, will be found satisfactory.

The more the surface is rubbed the brighter it will be, whereas with varnished or French polished surfaces, carriages for either railway or road are never in service long before they lose their polish. Painting done in this manner is really metallic enamelling, and gives a finish far surpassing ordinary painting as well as preventing the possibility of cracking, blistering, &c. As the paint is really baked on the vehicle at a higher temperature than when standing in the sun, the yard of a station, or a coach house, all lettering can be done as usual after the last coat has been finished, the vehicle being stoved again to harden the lettering. Once the heat is got up in the stove, it takes but little fuel to maintain it, and, it is declared that, painting on this system will last several times the life of ordinary painting, and the work will be completed in one-half the ordinary time on account of the quick drying. It will therefore effect a very great saving on work done by railway companies, private firms, and others who may choose to adopt it. To do this class of work as economically as possible, the stove should be made so as to turn the work out equal to the demand, that is, for railway companies the stove should be able to hold more than one vehicle.

CEYLON RAILWAYS.

The Blackwater Slip.

"Mr. Spooner's Hydrometric Monitor."



Herewith is a rough sketch (curtailed longitudinally) of the above machine. Fixed on the main of 1 foot diameter is a ball and socket joint of gun metal, then a tapering or reducing pipe, on the end of which is fixed the jet with a 2-inch nozzle with movable lip. The reservoir to feed this machine was 30′ × 30′ × 3′.

Mr. Spooner said that he would clear the slip in 15 days, taking away all soil and stone blocks up to five tons in weight. The virtue of these machines is said to consist in the reducing pipe. I don't see this at all. I only see in it a jet, which with a head of 190 feet would eject the water to a height of 162 feet, with a pressure of 82·27lbs. per square inch at the sluice. Now from above it will be seen that provided he had sufficient water he had ample pressure to overturn a block of granite of 68·29 cubic feet and weight five tons, but he really had no more pressure on than would overturn a stone of 50lbs. The machine, of course, cleared away the loose earth and smaller stones. The expense in connection with this experiment has, it is said, cost the Colony Rs. 10,000, and it fails, in my opinion, from want of due care being taken in cutting the storage reservoir. It was too small, and they were utilizing the overflow for helping down the earth and small stones. It would appear there was plenty of water; in fact, there was not storage enough to fill the pipes, and the anicuts were too low to allow the water to flow in as fast as the pipes would empty the reservoir.

Surely we are retrograding! In this our 19th century, we spend Rs. 10,000 over failing to move a five-ton block to waste, and our forefathers moved a 1,500-ton mass of granite for the statue of Peter the Great!

Frank W. Thomson, B.E., M.I.C.E.I.

P.S.—Just as they were making everything snug for passage of goods' trucks a fresh slip has occurred, filling up the cutting afresh. This is serious as the traffic is increasing and the supply of trucks at the Nanu Oya end is found inadequate. F. W. T.

A NOTE FROM BURMAH.

In the acquisition of Upper Burmah, the difficulties of procuring materials for works of public utility and construction, will in a great measure be lessened, as soon as carrying power becomes available. The country abounds in granite serpentine, laterite, gravel, limestone, sandstone, and clays of a superior quality.

The main source of road material for Lower Burmah, was hitherto obtained from the shipping touching coming to the Province with stone ballast, and from Mergui and Salween; but the want of carrying power and easy communication, the supplies from the latter sources were considered unprofitable when brought to this port. So far our wants have been supplied from these precarious sources; but the demand for building and road material will soon become much greater, when difficulties will surely arise, unless the local reserves are properly worked. Tennasserim has granite and gneiss, Pegu limestone and clays, Arracan serpentine and sandstone, and all the hilly country from Moulmein northwards. Prome on either banks of the Irrawaddy possesses limestone and sandstone and laterite; and it is from these accessible sources that our supplies should be met.

The clays from Pegu have been long known for their superiority. In many places the beds consist principally of China clay, free from iron, and consequently well suited for manufacture of china-ware, glazed pottery and tiles. The common alluvial clay to be had anywhere in the province, is what is now used for making bricks, tiles and pottery. The clay requires no special preparation beyond a little kneading with water, before moulding. The Public Works Department only use the latter for brick-making. This industry only requires capital and enterprise to develop the crude method as now worked by native potters and brickmakers, as well as to keep up a sufficient supply to meet all local demands and to improve generally the materials for manufacture.

H. T.

THE MEER ALLUM LAKE AND DAM.

THE reservoir shown in the annexed sketch, which is copied from a photo, is situated about two miles from the City of Hyderabad, the capital of His Highness the Nizam's dominions. It was constructed about A. D. 1808 by Nawab Meer Allum, the Prime Minister of the State, under the immediate orders of an Engineer Officer named Captain Russell, during the reign of His Highness Sikander Jah. The area of the lake is about one-and-a-half square miles, and it is the chief source of supply for providing drinking water to the inhabitants of the City of Hyderabad. The principal feeder to this lake takes its rise from the River Esee near the village of Yerselgandy, some miles away. The masonry dam, which is thrown across a valley debouching towards the Moosee river, is of great solidity and strength, and on a principle as unique as it is effective and lasting. It has the appearance of a bridge with several arches as if laid upon one of its sides, and it not only presents this appearance, but it is actually built upon the principle of the arch in the position stated. The resistance it thus presents to the pressure of the water is obviously more formidable and complete than a dam built according to the ordinary practice. The number of arch-like structures is twenty-one, each of about one hundred and fifty feet span, resting upon piers supplemented by buttresses, the entire structure again assuming the appearance of one large arch. The breadth of masonry at the top is about four to five feet, and increases in thickness to the foundations. The greatest depth of water is about fifty feet, and when at its highest during the monsoons flows over the crest of the dam in a fine cascade, and renders the whole scene one of great beauty. A notable feature in the landscape on the west side is a *dargah* or shrine in which are deposited the remains of two Mahomedan saints. Several *fakeers*, who are in charge, show great politeness to European visitors, and point out the entrance inside the enclosure of the *dargah* of an underground passage which leads (if it can be credited) to the celebrated Fort of Golcondah. Four steam yachts have been placed on the lake belonging to His Highness the Nizam and Nawab Salar Jung. These yachts are willingly and generously placed at the disposal of pleasure parties visiting this neighbourhood. It is a gratifying fact, which ought not to pass unnoticed, that though the lake described is the private property of the Salar Jung family, the water is supplied free of charge to the inhabitants of the City and suburbs of Hyderabad. The photo of this lake was taken by Messrs. Monkenteller and Co., and this description has been kindly furnished us by Mr. J. B. Buchanan, A. M. I. C. E., District Engineer, Hyderabad.

ON "DRIFT" IN GUN FIRE.

By A. EWBANK, M. A.

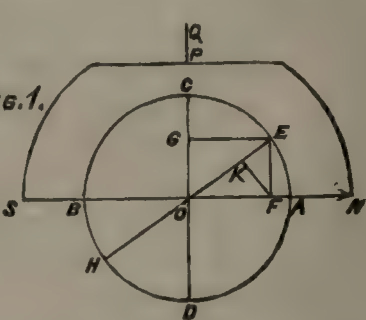
ONE of the questions coming up for solution before the English people is the defence of India and the Colonies from a sudden attack by an enemy's fleet. Thus artillery questions are to a certain extent popular questions, and they are certainly engineering questions. We will therefore discuss in as elementary a manner as possible, consistently with due completeness, a peculiarity in artillery practice known to gunners as *drift*.

Let a rifled cannon be placed so as to discharge a projectile northwards, *i.e.*, in the plane of the meridian. As to the shape of the projectile, we may state at the outset that no particular shape is implied in the following discussion. It cannot be a perfect sphere, for then it would not take the rifling, *i.e.*, it would not acquire that rotation (about a line on it, which we will call its "axis of figure,") which it is the object of the rifling to impart. In order to keep this discussion as short as possible, we omit all inquiries as to the reason why a rotation of the projectile is desirable. Moreover, mathematicians have already assisted artillery officers with explanations why a rotation of the projectile is useful in increasing accuracy of aim. But they do not as yet appear to have supplied students of gunnery with an explanation, theoretical, rigorous and intelligible, of the thing which is called *drift*. In a manual chosen by Government for the use of artillery students at Woolwich, the subject of "drift" is mentioned; but after various recondite causes—not excluding air vortices—have been summoned to explain the matter, the "drift" is finally left as a thing unexplained, if not also a thing which is unexplainable. We proceed to supply this omission.

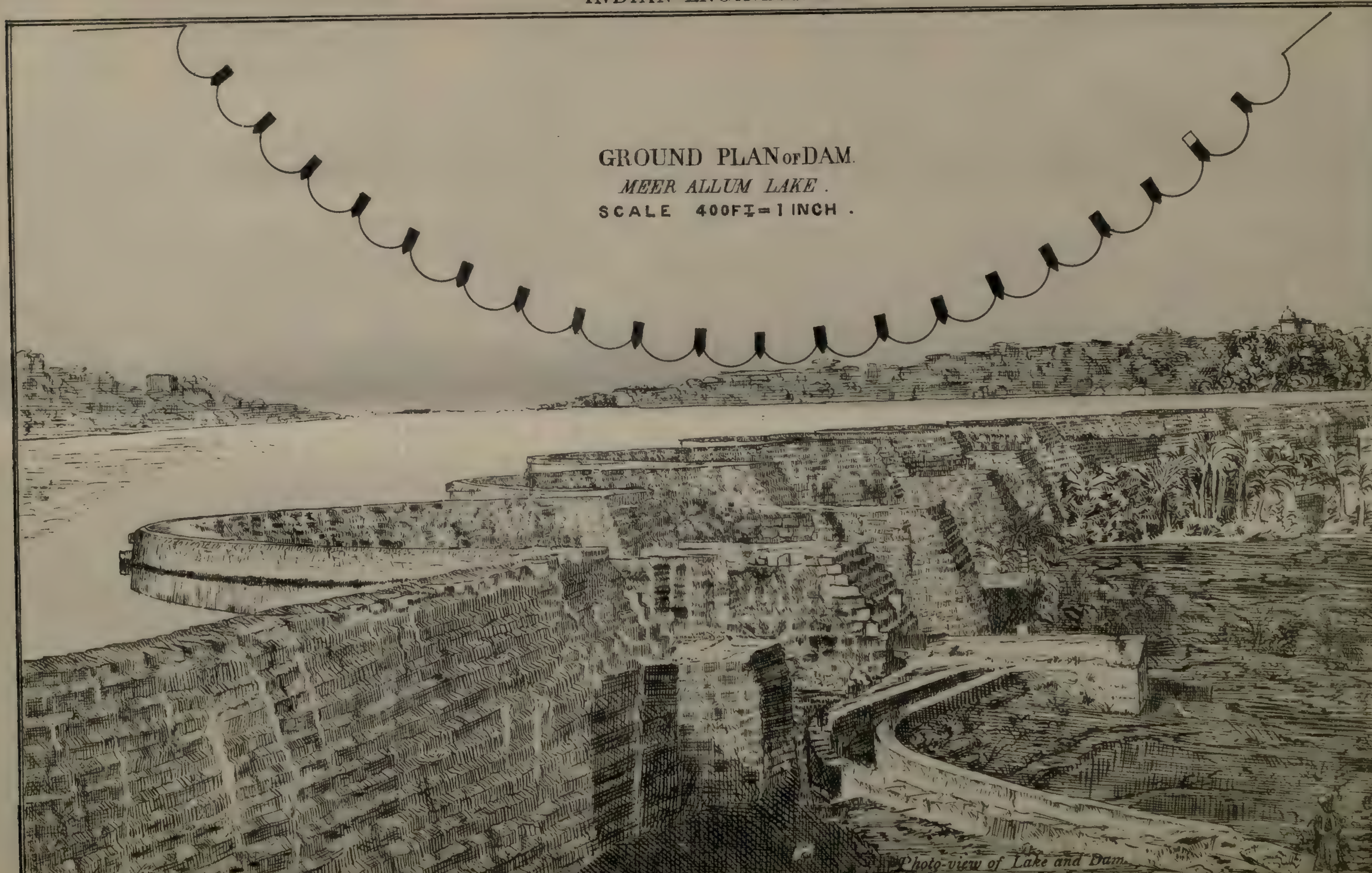
When the projectile is fired northwards and in the meridian, it might be expected that it would ultimately strike the ground, which we will suppose to be horizontal, at a point due north of the starting point. In other words, we should expect it to keep in the meridian. If fired initially in any other vertical plane, we should equally expect it to keep *in* that vertical plane. Its *not* keeping in the vertical plane in which it initially moved is the feature described as "drift." In fact, the projectile behaves somewhat like a round shot, without rotation, might behave if, while it was flying towards the north, a strong wind was blowing from west to east. The rifling is such that the projectile on leaving the barrel has a clockwise or right-handed rotation. There is no theoretical reason for choosing this rotation. It is simply a matter of custom. If the rotation were left-handed or counter-clockwise the deviation would be westwards, still supposing the meridian to be the initial plane of projection.

This peculiarity is so recognised by gunners that allowance is made for it in fixing the *sights*. In other words, the sights are set wrong in anticipation that the drift will correct matters and send the projectile where it is meant to go. Readers of the following explanation may find it useful to help their conceptions with a globe of wood—easily made by any carpenter—or any object approximately round which they find handy, such as a water bottle.

FIG. 1.



If any solid body—we will suppose it a sphere, though the argument does not fail to apply to all other shapes as well—is rotating about an axis which is horizontal and points due north, every point of the body describes some circle whose centre is in that axis, and whose plane is at right angles to the axis. Similarly, for a vertical axis of revolution, every point of the body moves in some circle whose plane is horizontal. In figure 1, let the circle A C B be a section of the spherical projectile by the meridian. Let the sphere be spinning about the horizontal axis B A where B A points due north. Suppose this axis produced to the points N, S, where O N = OS, and imagine S N a material axis about which the sphere turns—the line S N itself not turning, but piercing the sphere through its centre. This thin material axis—say a thin iron rod—may have its ends S, N, fixed in a stirrup O P S, N. P Q is on the prolongation of the vertical diameter D C, and if P Q be made to rotate, the points S, N, are carried round in a circle of radius O N. N S being a material axis will carry the sphere round with it. While the sphere is thus virtually spinning about the vertical diameter D C let it keep its original spin about the axis B A. As a matter of fact, if the sphere is set spinning about the axis B A it will oppose a certain resistance to having this axis moved from the initial position pointing due north. But this resistance may be supposed overcome by sufficient force and so the diameter B A is made to spin about the diameter D C. Thus the sphere


GROUND PLAN OF DAM.
MEER ALLUM LAKE.
SCALE 400FT = 1 INCH.
Photo-view of Lake and Dam.

has at the same time *two* rotatory motions—(1) it spins about B A, and (2) B A and all other points of the sphere have an additional rotatory motion about D C.

Dismissing now the material axis and the stirrup P S N—which were only introduced to help the reader to conceive of the co-existence of two separate rotations—we may say that the sphere has at the same time a spinning motion round B A and a spinning motion round D C. Let the rotation round B A be such that the point C moves out of the paper *towards* the reader. This is right-handed *if* seen from S. Let the spin round D C be such that A is moving out of the paper *from* the reader. This is counter-clockwise or left-handed *if* seen from P. The spin about D C will bring B A back periodically into the plane of the paper—which plane denotes the meridian. Now the question is, what sort of motion does the sphere possess as the resultant of the two spins about O A and O C? The question is asked not for any time in general, but for the exact moment when O A is crossing the meridian. To make our ideas more precise, let us suppose that the spin round B A is such that the sphere revolves four times per second. Let the spin about D C be such that it makes O A (or the sphere generally) revolve three times per second. Draw the line H O E such that the tangent of the angle E O A shall be $\frac{3}{4}$. Draw E F perpendicular to O A and E G to O C. Then the velocity of the point E as due to the spin about O A is such as to make E describe in one second four times the circumference of the circle whose radius is F E. Its velocity is therefore 8π E F and it is, at the moment considered, normal to the paper and *towards* the reader. In like manner by virtue of the spin about D C, E has a velocity $3 \times 2\pi$ E G which is normal to the paper and *from* the reader as the spin about D C is left-handed, as seen from P. Now by construction E F : E G = 3:4. Therefore 8π E F = 6π E G. Therefore E having two equal and opposite motions is kept at rest. Similarly for any other point in the line H E. Thus the sphere by reason of simultaneous spins about O A, O C, is made to spin about the line H E. For the sphere has some motion and H E has no motion. The spin velocity about H E *at the moment* O A is in the meridian will be such that the body is revolving about H E at the rate of five revolutions per second. For let the number of revolutions round H E be called n. Draw F K perpendicular to H E. Then the velocity of F at the moment considered must be $n \times 2\pi$ F K. But the velocity of F is $3 \times 2\pi$ O F by virtue of the original spin about O C while it gets no motion from the spin about O A. Therefore n. F K = 3. O F. But $\frac{K F}{O F} = \text{Sin E O F} = \frac{3}{5}; \therefore n = 5$. And as F moves out of the paper *from* the reader by the spin about D C, it follows that the spin about H E must be such as to produce this direction of motion in F. Therefore the motion about H E is right-handed or clockwise *if* received from a point on O H produced. When O A is out of the meridian the resultant spin axis is also out of the meridian.

Conversely, if a sphere is spinning about the line H E which makes with the horizontal north line B A an angle whose tangent is $\frac{3}{4}$, and if the spin velocity is five complete revolutions per second, this motion may be represented by giving to the sphere simultaneous angular velocities about the line B A and the line D C. These lines are fixed *in space*, but not fixed *in the body*. The motion about H E will carry that line *of the body*, which at present is due north and horizontal, into some other position which is out of the meridian and is not horizontal. Then some other line *of the body* will occupy for the moment the position of O A in the figure. Similarly the spin about H E will take that line *of the body* which at present is vertical into some other position which is not vertical. Another line of the body—say a line O V—which makes an angle V O E=the angle C O E—will come to the vertical position denoted at present by O C. About this new line O V of the body we may then suppose a spin given at the rate of three revolutions per second, and along the new horizontal north line we may suppose a spin of four revolutions per second. Thus the continued constant spin about a diameter of the sphere fixed *in the body*, and also fixed in space as far as direction goes, may be replaced by two certain smaller spins about diameters which are fixed as regards their directions in space and are therefore *not* fixed in the body.

Now, if the above reasoning be allowed to be valid, we see that to cut out of the sphere any portions of its material will not affect the above reasoning as regards the remaining portions. We shall then have some irregular figure which is really spinning about a line H E. This irregular figure is then supposed to lose its spin about H E and to take instead certain other spins about two other lines B A and D C which have certain fixed directions with reference to the line H E. These other lines we describe by saying that they are fixed in space but are not fixed in the body. Now, by cutting portions from a sphere we may make the remainder into any shape we like—say cylindrical, conical or altogether irregular. Thus we see that our reasoning about replacing one spin by two other spins is independent of the shape of the body operated on.

(To be continued.)

NOTES FROM HOME.

(From our own Correspondent.)

"The use and equipment of Engineering Laboratories" was the subject of the paper read at the last meeting of the Institution of Civil Engineers. In this paper the author points out that in an ordinary pupilage a young Engineer has not much opportunity of studying such things as the physical properties of iron and steel, nor the strength of those materials, nor the efficiency of the machines he uses, nor the relative economy of the different types of engines, nor the evaporative power of the boilers. For such experience, he requires to see for himself how the different Engineering constants have been arrived at, from the strength of iron to the value of coal or the discharge co-efficient of an orifice. The author thinks that this kind of practical, teaching can be given best in an Engineering Laboratory, and points out that England has taken the lead in these matters, and concludes his paper by pointing out the principal subjects on which experiments might be carried out in these laboratories as suggested.

The morning that London woke to find itself as completely cut off from one means of communication with the outer world looked as if an investing army were encamped around the city. A snow-storm and a few hours of tempest had brought us back to the conditions under which life was carried on previous to the use of the electric telegraph. Out of nearly 500 wires from London to places outside the metropolis only six were left in working order. Except the underground cables there was hardly a telegraph or telephone through which a message could be sent. The experience of this month will undoubtedly lend force to the argument of underground wires. The Railways have had to be worked under the old "time" system and when considered in connection with dense fogs which have prevailed, it is wonderful the immunity of accident which has been attained.

It appears that orders in shipbuilding have been a little more lively during the last two months than has been the case for some time. Besides that freights are slightly on the rise, there is another very strong inducement for the building of new steamers to replace the old fleet. The present mechanical arrangements of "triple expansion engines afford so much greater economy in daily work that a vessel so fitted competes at greater advantage with the older fleet, and can make a living at low freights when it would be impossible for older vessels to do so. From Mr. Wyllie's paper recently read before the Mechanical Engineers' Institution it appears that steamers by this agency burn 30 per cent. less coal than was the case five years ago. An instance is mentioned in the discussion which followed this paper of two large steamers recently built for the P. and O. Company of 6,000 I. H.-P. each of the same dimensions and built on the same lines. One worked with a triple engine at a pressure of 145lbs. to the square inch and the other with an ordinary Compound working at 90lbs. pressure per square inch. Both sailed to Australia, at 12 knots per hour, and the vessel with the triple engine burned 1,200 tons less than the compound.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, January 24, 1887.

Mr. W. Wiseman, Executive Engineer, 2nd grade, State Railways, is temporarily transferred from the Establishment under the Director-General of Railways to Burmah Provincial establishment.

It is hereby notified that in Railway Despatch, No. 118, dated the 23rd December 1886, Her Majesty's Secretary of State for India has accorded sanction to the estimate amounting to Rs. 27,22,940 of the cost of constructing an extension of the Sind-Pishin State Railway from Quetta to the Kotal at the top of the Bolan Pass.

Mr. T. E. Owen, Executive Engineer, 1st grade, State Railways, Engineer-in-Chief of the Benares-Cuttack-Puri Railway Surveys, officiated as a Superintending Engineer in the 3rd class, during the absence of Mr. F. B. Walker on privilege leave.

Mr. E. I. Shadbolt, Executive Engineer, 3rd grade, State Railways, is transferred from the establishment under the Director-General of Railways to that under the Government of Bombay, for employment on the Porbandar-Dhoraji Extension of the Bhavnagar-Gondal Railway.

This cancels the transfer of Mr. H. Johnson, Superintending Engineer, ordered in Public Works Department Notification No. 322, dated 19th November 1886.

Central India.

Mr. C. E. Gael, Executive Engineer, 2nd grade, has been appointed as Personal Assistant to the Superintending Engineer, Central India, from the 11th January 1887.

Railways.

Mr. W. Drew, Assistant Engineer, 1st grade, passed the Lower Standard Examination in Hindustani on the 8th December 1886.

Lieutenant-Colonel E. N. Peters, R.E., Executive Engineer, 1st grade, is granted leave on private affairs for one year, with the usual subsidiary leave, with effect from such date as he may avail himself of the same.

Madras, January 25, 1887

Major A. C. Smith, R.E., Superintending Engineer, 3rd class, sub. *pro. tem.* is granted furlough on private affairs for one year, one month and fourteen days, from or after the 17th February 1887, under section 50 of the Civil Leave Code.

Mr. C. Vincent, Executive Engineer, 3rd grade, from the I Circle, Ganjam Division, to the II Circle, for charge of the Buckingham Canal Division, to join at the public expense on relief by Mr. H. E. G. Evans, Executive Engineer.

Mr. H. E. G. Evans, Executive Engineer, 4th grade, sub. *pro. tem.*, to the I Circle for charge of the Ganjam Division, to join on return from furlough.

Mr. J. J. Whiteley Executive Engineer, 4th grade (temporary rank), Assistant Engineer. 1st grade, from 8th December 1886.

Mr. G. E. Manson, Assistant Engineer, 1st grade to be Executive Engineer, 4th grade, from 8th December 1886, temporary rank.

Mr. J. J. Whiteley, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, from 8th January 1887, temporary rank.

Bombay, January 27, 1887.

The following promotions are made, *vice* Colonel J. R. Maunsell, R.E., who has retired from service, from 2nd November 1886 :—

Colonel C. A. Goodfellow, V.C., R.E., Superintending Engineer, 1st class, permanent.

Colonel A. T. Mander, R.E., Superintending Engineer, 2nd class, permanent.

Colonel W. M. Ducat, R.E., Superintending Engineer, 3rd class, permanent.

Mr. G. N. R. Lambert, Executive Engineer, 1st grade, permanent.

Mr. A. Davidson, Executive Engineer, 2nd grade, permanent.

Mr. J. G. Single, Executive Engineer 2nd grade, sub. *pro. tem.*

Mr. S. Rebsch, Executive Engineer, 3rd grade, permanent.

Rao Bahadur G. R. Tilak, Executive Engineer, 4th grade, permanent.

Mr. W. L. S. L. Cameron, Executive Engineer, 4th grade, sub. *pro. tem.*

Rao Saheb Parashram Krishna Chitali, Assistant Engineer, 1st grade, permanent.

The following reversion and promotion are ordered from the 12th January 1887, the date of Mr. J. Young's return to duty :—

Mr. J. G. Single to revert to Executive Engineer, 3rd grade.

Mr. J. Young to be Executive Engineer, 2nd grade, sub. *pro. tem.*.

N. W. P. and Oudh, January 29, 1887.

Buildings and Roads Branch.

Babu Sohan Lal, Assistant Engineer, on return from the two months' sick leave was attached to the Office of the Superintending Engineer, 1st Circle, Provincial Works, from the 24th July to the 2nd August 1886, both days inclusive.

Irrigation Branch.

Major T. Howard, R.E., Executive Engineer, Anupshahr Division, Ganges Canal, is granted three days' extraordinary leave, from 17th to 19th November 1886, both days inclusive, in extension of furlough.

The following promotions and reversion have effect from the dates specified :—

Mr. A. M. Fagan, from Assistant Engineeer, 1st grade, to Executive Engineer, 4th grade, 26th November 1886, temporary, *vice* Major Home, R. E., promoted to Chief Engineer, 3rd class, temporary rank.

Mr. A. C. Polwhele, from Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, 18th December 1886, sub. *pro. tem.*, *vice* Lieutenant Thackwell, R. E., permanently transferred to State Railways.

Mr. A. M. Fagan, from Executive Engineer, 4th grade, temporary, to Assistant Engineer, 1st grade, 7th January 1887. consequent on the return of Colonel Jeffreys, R.E., from furlough.

Mr. C. Hill, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, 11th January 1887, sub. *pro tem.*, *vice* Mr. Greer, permanently transferred to the Panjab.

Mr. A. M. Fagan, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, 11th January 1887, temporary *vice* Mr. Greer, permanently transferred to the Panjab.

Mr. H. C. Sanders, from Assistant Engineer, 1st grade, sub. *pro tem.*, to Assistant Engineer, 1st grade, 11th January 1887, permanent *vice* Mr. Greer permanently transferred to the Panjab.

Bengal, February 2, 1887.

Irrigation.

Mr. G. C. Stawell, Assistant Engineer, 2nd grade, attached to the Aquapada-Jajepore Division, passed the examination in Hindustani by the Lower Standard on the 3rd instant.

Burma, January 22, 1887.

Mr. W. Giles, Assistant Engineer, 1st grade, reported his arrival at Rangoon on the forenoon of the 19th December 1886.

Mr. H. J. Richards, Superintendent of Works, Upper Burma, made over, and Mr. E. J. Rumsby, Executive Engineer, 3rd grade, sub, *pro tem.*, received charge, of the Mandalay division on the forenoon of the 3rd instant.

Mr. C. E. Housden, Executive Engineer, 4th grade, sub. *pro tem.*, reported his arrival at Rangoon on the forenoon of the 16th instant.

Mr. Housden's services are placed at the disposal of the Superintendent of Works, Upper Burma.

Lieutenant W. R. Morton, R.E., Assistant Engineer, 2nd grade, is transferred from the Mandalay to the Rangoon Division, which he joined on the forenoon of the 7th instant.

Assam, January 29, 1887.

In continuation of orders granting three months' medical leave to Rai Gopal Chandra Chattapadhya Sahib, Assistant Engineer 1st grade, a further extension of sick leave up to the 7th April 1887 is hereby granted to this officer.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

20th January 1887.

2 of 1887.—Illius Augustus Timmis, of 2, Great George Street, in the City of Westminster and County of Middlesex, England, Civil Engineer.—*For improvements in the arrangements for electrically lighting railway trains.*

7 of 1887.—John William Hall, of 13th Solway View, Whitehaven, in the County of Cumberland, England, Engineer.—*For improvements in stoppers for bottles and other vessels.*

27th January 1887.

115 of 1886.—John Gray, Rice Miller and Engineer, residing at Kyemyendine in the City of Rangoon, Province of British Burmah, in the Indian Empire.—*For improvements in rice cleaning and in rice cone or drum cases employed therefor.*

235 of 1886.—William Beilby Avery, of Digbeth, Birmingham, in the County of Warwick, Machine Maker.—*For improvements in machinery for weighing grain and other substances.*

11 of 1887.—Samual De la Grange Williams, of Woodgate, Malvern, in the County of Worcester, England.—*For a construction of Lock Nut.*

SELECTED ABSTRACTS OF RECENT INDIAN SPECIFICATIONS.

An improvement in overhead lamps.—204 (1886).—*Albert Marcius Silber.*—This invention relates to lamps suitable for roofs of Railway carriages or for ceilings of apartments or for other positions where the light has to be directed mostly downwards—the lamps being of a known kind, in which a flat wick tube projecting nearly horizontally towards the centre of a conoidal reflector is situated above the level of an annular oil reservoir arranged in a cool position around the outside of the reflector. In such lamps, the horizontally projecting wick tube is enclosed within an air tube which terminates in inwardly turned lips that deflect the air against the flame, and as these lips are beyond the end of the wick tube, it is difficult to adjust the wick and to kindle the lamp. The main object of this invention is to provide for ready access to the wick tube and to such other parts of the lamp as

require cleaning and adjustment. For this purpose the air tube which surrounds the wick tube is made in two parts—the lower part fixed to and projected inwardly from the reflector; the upper part movable as a door, giving access to the wick tube which projects upwards and inwards from the reservoir in the lower part of the casing which contains the reservoir at its lower angle. Above this lower part of the casing there is an upper part hinged thereto or fitted thereon, and this in the case of Railway carriage lamps or of lamp exposed to currents of air is provided with openings for passage of air to supply the flame and ventilate the lamp and for issue of the heated air and products of combustion; all these openings being shielded by wind-guards. On removing this upper part, access can be got to open the upper part of the air tube, and when this is opened the wick tube is exposed, so that the wick can be adjusted and the lamp can be kindled. The reservoir is below the mouth of the wick tube, so that the flame is fed by capillary attraction; and around the reservoir there is free circulation of air keeping it cool, consequently almost all oils, including those that are somewhat volatile, can be used for the lamp. Instead of a single flame, two, three or more can be directed from the circumference towards the centre of the conoidal reflector, which is surmounted by a chimney taking off the products of combustion from them all.

Improved manufacture of explosive compound and the preparation of cartridges therefrom.—105 (1886.)—*Sir Francis Bolton, Kt.*—This invention relates to the manufacture of an explosive compound of great power, composed of a solid constituent and a liquid constituent, which, being non-explosive in themselves, are capable, when necessary, of being transported separately with perfect safety to any desired locality where the explosive compound is produced, by simply saturating the solid constituent with the liquid constituent. The solid constituent employed is a suitable chlorate, by preference chlorate of potash, and the liquid constituent is a solution of a carbonaceous material in a separate solvent, for which purpose, preferentially, nitro benzole containing resin or colophony in solution, is employed; but other solvents, such as oil or spirits of turpentine, kerosine, camphine and the like, and other carbonaceous material such as molasses, syrup or other saccharine matter may also be used. The mode in which the inventor prefers to prepare and use the said solid and liquid constituents is as follows: The chlorate of potash reduced to a coarse powder is packed in cartridge cases or tubes of any desired size, the filling being effected in a similar manner to that of rockets, so that a central bore or space is left in the mass. The central bore or opening may be protected by means of a lining of wire gauze, to avoid the crushing in of the powdered chlorate, and to preserve the opening. When a cartridge is required for use, a quantity of nitro benzole, containing resin or colophony in solution to the extent of 15 per cent, is poured into the central tube or opening of the cartridge and allowed to soak into the powderd chlorate. It is preferred to use ¼ the weight of the chlorate of this solution to give a good result. The cartridge thus prepared is now treated in all respects as if it were charged with dynamite, the ordinary fuze and detonator which is used for dynamite being inserted in the cartridge and used in precisely the same way with this compound.

At a meeting of the Geographical Society of Paris in December last, M. de Lesseps again declared that the Panama Canal would be open for traffic in 1889. He added: "There will not be sufficient time for the construction of locks; we shall make them later on. The essential point is that by the date mentioned shipping shall be able to pass through the Canal."

Extracts.

FUTURE CATHEDRAL.

A few details concerning All Saints' Church, Cannington, Allahabad, will be of general interest. In 1869 an application to Government for the present site with the adjacent plots was made, and the ground was formally handed over to the Church Committee on 7th June 1870. During the year 1870 Mr. Emerson's plans were accepted. The roads were laid out and tenders asked for. By January 1871 a sum of Rs. 14,000 had been collected. At length, on Easter Monday, 10th April 1871, the first stone of All Saints' Church was laid by Lady Muir, wife of Sir William Muir, then Lieutenant-Governor of the North-Western Provinces, in the presence of the Lord Bishop of Calcutta (Bishop Milman). During 1871 and 1872, in spite of urgent appeals, funds came in but slowly. In May 1872 the Lieutenant-Governor promised a grant of Rs. 12,000 in two years, conditional on the completion of the church, but this was impossible, and the grant lapsed. The building is, therefore, from first to last, the result of private munificence. The building was resumed in February 1885; and although much still remains to be done, and opinions may differ as to matters of detail, a church which all must acknowledge to be worthy of the growing importance of this great station will be consecrated on Wednesday next. Throughout the progress of the building the work has had the benefit of the gratuitous supervision of skilled Engineers, on whom, owing to the residence of the architect in England, much labour and personal responsibility has fallen. For many years this was undertaken by Mr. Graham Peddie with ungrudging care and devotion. In later times Mr. H. S. Talbot superintended with equal skill and energy the resumed operations; while since his transfer to another station, Mr. Joseph and Mr. E. Hodges have freely given advice and practical assistance. For the selection and preparation of the Jeypore marble for pavement and steps, designed by Mr. Talbot, thanks are due to Colonel S. S. Jacob, R.E. The Contractors, Messrs. Frizzoni and Co., have carried out the work in no perfunctory way and have spared no pains to provide the best materials and workmanship. The practical completion of their contract, under great pressure at last, reflects much credit upon them, and the excellent quality of the work will be a standing testimonial to their resources and skill.

THE NAVIGABLE CANAL SYSTEMS OF BENGAL—1885-86.

These systems have generally been passed over with only a cursory notice in previous reports. As a fact, however, the revenue they bring to the province compares very favourably with that derived from the irrigation operations alone. The navigation revenue from all the canals, including the Naddya Rivers exceeded ten lakhs of rupees during the year; the maintenance charges, including special establishments, being less than five lakhs. The total weight of the goods which passed along these canals during the year was more thon 1,800,000 tons, which was assessed at about 1,100 lakhs of rupeos in value. The greater portion of this traffic was on the Nadya River and the Calcutta Canals; and the value of the goods carried to Calcutta by the latter Canal alone aggregated some 550 lakhs of rupees. It is a remarkable fact that these Calcutta Canals, which were originally constructed from provincial funds, and which have within the last ten years been greatly improved at the expense of the province, are far more remunerative to the State than the costly works in Orissa, Midnapur, and Shahabad which have been constructed at the expense and, more or less, at the instigation, of the Imperial Government. The Calcutta Canals, during the last ten years, have given a net return of five-and-a-half per cent. of the capital invested, including the sum of some twenty lakhs which has been expended upon them during that time. They are by far the most remunerative public works in Bengal, and would well repay the execution of the still further improvements which, we believe, are in contemplation.

Notices.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Answers to Correspondents.

SEVERAL Contributions are unavoidably held over, but we have increased our space, as a temporary measure, to dispose of arrears.

Obituary.

GOODCHAP.—In London, on the 5th January, William Alfred Goodchap, C.E., late District Engineer of Kurnool, Madras, India, aged 62 years.

MABERT.—At Jubbulpore, on 28th January 1887, Alfred Swanhill Mabert, Manager, Oil Factory, E. I. R., Manowrie.

INDIAN ENGINEERING.

SATURDAY, FEBRUARY 12, 1887.

THE BATTLE OF THE GAUGES.

I.

IN his speech at the half-yearly meeting of the shareholders of the Bombay, Baroda and Central India Railway, held in London at the close of last year, the Chairman of the Directors, General Trevor, as we have already noticed, enlarged upon the necessity for taking steps to enable the Rajputana-Malwa System of Railways, which his Company have leased from Government, to meet the rapidly increasing amount of traffic. The line, he explained, being built on the metre gauge, cannot carry much more than ⅗ths of the traffic that can be carried by a broad gauge (5 feet 6 inches) line. And to double the line would be practically equivalent to constructing a new railway, for it had been built, bridges and all, to carry only a single track.

We do not propose to go back on the earlier controversy as to the relative merits of the respective gauges, that was not closed by the decision of Government, at the instance of the brothers Strachey, backed up by Mr. A. M. Rendel, the Consulting Engineer to the India Office, to construct the Rajputana-Malwa System of Railways on the metre gauge. By 1875, the line had been opened from Delhi and Agra to Ajmere, 396 miles. In 1879, Mr. E. B. Carroll, M. Inst. C. E., the Locomotive and Carriage Superintendent of the Bombay-Baroda line, wrote a comparison between this metre gauge railway and his own and the Great Indian Peninsula broad gauge railways, and while pointing out that the cost of the Rajputana line, by the time it should be properly fenced and equipped with rolling-stock, would probably reach £8,000 a mile, (the capital expenditure on the 1,413·5 miles opened to 31st March 1885 actually was Rs. 11,09,73,569, or Rs. 78,509 per mile) against £9,733, the mileage cost of the Oudh and Rohilkund Railway, and £7,200, the mileage cost of the Wadhwan Extension of his own broad gauge railway, he argued, from the figures he gave of the comparative cost of working, that in every case where the metre gauge line was judged by the actual work done in tonnage, number and distance, it was far inferior to the broad gauge lines. No other result, he said, could be expected. It could never be an economical arrangement to employ two or three trains and locomotives to do the work done on a broad gauge line by one train and one locomotive; yet this was what it had been wilfully elected to try upon the Rajputana Railway.

The controversy was carried on by Lieutenant H. Pilkington, R.E., a Deputy Consulting Engineer for Railways, who without entering into the general question of Broad *versus* Narrow gauge, or the disadvantages of break of gauge endeavoured to show that so far as the Rajputana line itself was concerned, a fair percentage had been returned on a comparatively small original outlay, and that the metre gauge line was capable of carrying three times the traffic then carried between Dehli and Agra and Ajmere without doubling the line. Lieutenant Pilkington's memorandum was reviewed by Mr. J. O'Connell, the Chief Auditor

and Accountant of the Bombay and Baroda line, who showed that the charges for working the Rajputana Railway would have been nearly 45·82 per cent. less per ton-mile had the line been worked at the same rate as the Great Indian Peninsula line, and 46·66 per cent. less at the Bombay, Baroda and Central India Railway rate, and that thus, had it been a broad gauge line, it would have been then paying over 6 instead of only 3·12 per cent.

Mr. Rendel, with apparently only Mr. Carroll's paper before him, which meanwhile had formed the foundation of a "memorial of the inhabitants of Bombay in public meeting assembled" to the Secretary of State, in May 1879 took up the cudgels for the metre gauge, and "being," as he said, "in a measure responsible for the adoption of the metre gauge in India," he proved to his own satisfaction, and doubtless to that of the India Office, that Mr. Carroll was all wrong, and that if all three lines had charged G. I. P. Railway rates the percentages of profit would have been G. I. P. Railway :—3·4, and B. B. and C. I. Railway — 3·75, both in 1874 (which year he took as the period of development of those lines corresponding to 1878 in the Rajputana line's history) against R.-M. Railway—8·6 per cent. Mr. Rendel, also, produced long arrays of figures in support of his contention ; but, then, we know that nothing is so fallacious as figures. And he said that results so far showed, without doubt, that whether they worked at the Rajputana or the South Indian (metre gauge) Railways, the practical capacity of the metre gauge for traffic was not likely to be approached by the traffic brought upon it. He said that the traffic of the Rajputana Railway was carried in little more than three trains, whereas at least twelve trains might be run each way on a single line, which would allow of a traffic of at least 1,500 passengers and 1,200 tons of goods per mile per diem, a traffic that no line in India, except the East Indian Railway, had yet carried, unless in time of famine. And he said that it was inconceivable, considering the competition of the Calcutta and Kurrachee routes, that the local traffic of the Rajputana Railway should approach these figures. From the Administration Reports on the Railways in India for 1885-86, we find that the traffic on the Rajputana-Malwa Railway was only 693 passengers, and 633 tons of goods per mile per diem, so that Mr. Rendel's anticipations with regard to the traffic were correct. But, on the other hand, the working Company are finding it too much for the railway, so that Mr. Rendel's estimate of the capacity of the line was quite extravagant.

THE LATE SIR JOSEPH WHITWORTH.—Sir Joseph Whitworth, Bart., F.R.S., mechanician, born at Stockport, in 1803, has resided in Manchester since he grew to manhood, and has been engaged in mechanical and manufacturing pursuits, being the head of the well known firm of Joseph Whitworth & Co. The first occasion upon which Mr. Whitworth's name came prominently before the public was as the inventor of some improved planing-machines, and other mechanical appliances for the manufacture of tools, in the Great Exhibition of 1851. Some years later, when the English Government were anxiously seeking to profit their military armaments, Sir Joseph Whitworth made improvements in projectiles, producing, as the result of his researches, fire-arms of extraordinary range and great accuracy. He has been, and is still, a competitor with Sir W. G. Armstrong in his efforts to produce ordnance for the national service, that may combine every important requisite. He was created a baronet in October 1869, in which year he instituted the "Whitworth Scholarships," consisting of thirty scholarships of £100 a year each, tenable for two or three years, for the encouragement of mechanical and engineering science. Sir Joseph Whitworth is the author of "Miscellaneous Papers on Practical Subjects ; Guns and Steel," 1873. The University of Edinburgh conferred on him the honorary degree of LL.D. in 1878.

TECHNICAL INSTRUCTION.

OUR readers are aware that both in political and educational circles in India a strong feeling is growing in favour of an extensive Government scheme of technical instruction. In countries like England where private enterprise is so largely developed that Government machinery plays a secondary part, it is generally sufficient for the Government to define a standard of excellence and private institutions or corporate bodies will easily work up to this standard. But in India the conditions are widely different. Science in India is still an exotic. Manufacturing industry is in its infancy. Commerce with countries over the seas is chiefly carried on by Europeans who live here temporarily for the purpose. In India it is not sufficient for the Government merely to sit at the helm and mark time for the rowers. Not only directing agency, but actual motive power must be supplied.

In England, some little time ago, the educational value of classical knowledge without physical or natural science was keenly discussed. In considering a scheme of Technical Instruction, we may simply aim at making skilful workmen, or we may lay down the principle that certain subjects should first be taught in order generally to cultivate the reasoning powers and afterwards any special scientific or technical training may be imparted for which there is time and opportunity. This latter view is often strongly urged by a class of educationalists who believe that all education should at first be decidedly literary. A school system that puts practical science in the forefront seems to them a system altogether wrong.

Thus the Very Rev. A. Neut, S.J., of Calcutta, has written a pamphlet in which he inveighs against the scheme of technical schools put forward by Mr. Tawney. Mr. Tawney, it may be observed, is distinctively a literary man. There is perhaps no man in India who is more competent than Mr. Tawney to appreciate the full value of a literary training as a means of education. To this pamphlet Mr. Ewbank, the Principal of the Government College at Patna, has written a reply. As this reply has nowhere else been made public, and as the question of technical instruction for India generally is one that this journal recognises as an important question of the day, we reproduce the reply in another column. Although our sympathies are naturally with the exponents of the value of a thorough scientific training, both theoretical and practical, yet it is well that there should be an opposite party to criticise their methods and ideas. It was Mr. D'Israeli—afterwards Earl Beaconsfield—who invented the admirable term "Her Majesty's Opposition." Not only in the House of Commons—not only in matters political—but in all matters which are of national interest there is room for "Her Majesty's Opposition."

From the letter in question it will be seen that the writer has taken up the defence of technical instruction neither solely nor chiefly as a matter of pure academics, but as a matter that concerns the whole industrial development of India. On this broader field, as it seems to us, the question is best surveyed. We are not aware whether the author

of the original pamphlet has taken any further steps to gain acceptance for his views, except some desultory letters to the Calcutta Press, which call for no remark.

THE INDIAN ENGINEERING COLLEGES.

Our correspondent "B. B.," whose letter we produce in another column, is, we are constrained to say, neither consistent nor logical, and he is evidently unacquainted with the true state of affairs in regard to the topics with which he deals. It is a well-known fact that the "Stanley" method of open competition proved a *failure*, because the paltry inducement then—1859-68—offered was too inadequate to tempt any Engineer, however young, who had spent time and money in qualifying himself for the Profession, to risk an Indian career. And as the junior appointments could not be satisfactorily filled up by "open competition," the Government had to meet its requirements by "selection." Accordingly a large number of Engineers of experience were engaged and appointed to the higher grades in the service. Even this experiment proved a failure, and so Cooper's Hill was started with the object of training young men specially as Engineers for India.

We have already enunciated our views on the Royal Indian Engineering College. We are in favour of the principle "a clear field and no favour." We believe that "open competition" has not had a fair trial, and if the Stanley method were tried again, the result would be all that is required—the very sort of men most needed. Until some such course is adopted, we fear that there will always be discontent both at Home and in this country among the many eligibles to whom the Indian Public Works Department is at present a closed "bureau."

In justice, however, to Cooper's Hill, we feel bound to remove some wrong impressions relative to the institution which have apparently gained wide currency. It is, we find, not generally known that the annual cost to each student at Cooper's Hill is £180 exclusive of medical attendance, class books, drawing instruments, and other necessaries. *Passed* Students appointed to the Indian P. W. D. are generally required to go through a course of *practical engineering* with Civil or Mechanical Engineers of standing, and while so employed only receive pay at the rate of £150 a year. A Passed Student not making a sufficiently good use of his time while on the practical course is liable to be required to go through a further course, *without pay*, before proceeding to India, and, in extreme cases, his appointment may be cancelled.

While we concede that Cooper's Hill is by far and away the best School of Engineering in the British dominion, we at the same time contend that its alumni are not necessarily the best men in the Empire, although we acknowledge that the education, training, and tests they have undergone render it unquestionable that those who come to India possess attainments above the average of those of the same age elsewhere qualified for the Profession.

"DIED ON THE LINE."

Their graves are set among forgotten ways,
By *jhil* and river-bed, by *ghaut* and plain,
A stone's throw from the labour of their days—
Their hand, their heart, their brain.

Their names are lost—their tale of work is done,
Each grass-grown hillock tells the story drear:—
"On Survey or Construction such an one
"Died, and was buried here."

The white mists of the forest, chill and damp,
The sun of noonday slew them at their toil,
The Pestilence in darkness smote their camp
Upon the rain-logged soil.

And some—God knows and He shall judge their case,
(Pray that their punishment on earth atone)
Who fell uncheered by any friendly face,
Cast out of hope—alone.

The angry East took all—what time they woke
Her Gods with thunder on the scarred hill crest,
With hurrying wheel and throbbing piston broke
Her immemorial rest.

Their headlamps drove a nation's darkness back,
Their whistles bade a hundred hatreds cease—
Their engines thundered down the echoing track :—
"Prosperity and Peace."

Through year on year, by life on life poured forth,
As water for an alien people's weal,
From utmost East to West, from South to North,
They sowed the patient steel.

Their graves are strown by upland drift and flood,
But, wheresoe'er they lie, our toiling band
Gives honour to the silent brotherhood
Who freed a fettered land.

* *

Notes and Comments.

Bengal Iron Works.—We learn that last December's was the best outturn of iron castings that has ever been made at Barakar. The best furnace turned out over 600 tons of pig-iron for the month. This speaks well for the Management. Operations will now be carried on night and day to clear off some heavy orders on hand before the end of the official year.

Bengal Coal.—The total quantity of the rail-borne down traffic for 1885-86 showed an increase of 5,41,189 maunds as compared with the figures for 1884-85. The importation into Calcutta from the Western Bengal block, in which the Raneegunge coal mines are situated, advanced by 3,73,019 maunds, and from Eastern Bengal by 1,20,397 maunds. In the up traffic there was an increase of 1,01,126 maunds. Last year the quantity sent to Behar from Western Bengal amounted to 3,19,289 maunds, against 2,48,886 maunds in 1884-85.

Tramways in the Straits.—The success that has attended the Singapore tram lines, which are barely a year in existence with extensions still in progress, soon infected the sister colony of Penang, where tramways will, in a few days, have become an accomplished fact. The difficulties of construction of the Penang lines, as regards actual labour, have not been so very formidable, but there were many intricate questions to elucidate and bring to a favourable issue; and it is highly satisfactory, therefore, to know that the project has reached so successful a termination.

New Works in Delhi.—Considerable activity is being manifested in building in Delhi at the present time. Messrs Meakin and Co., Brewers, are erecting a large malting godown at a cost of about seven lakhs. Another company have in progress a large steam flour mill, at a cost of six lakhs. The new Dufferin Hospital, to be erected by the Municipality, will cost about one and a quarter lakhs. The Municipality have also undertaken the repair of the

Jâma Musjid at a cost of upwards of a lakh. The Government are now carrying out extensive repairs and restorations of the remains of the Palace in the Fort.

THE MADRAS HARBOUR.—The Port Trust Board are unanimously of opinion that a north-east entrance is absolutely essential to the success of the Harbour, and declare that all those who have locally studied the subject, or who are personally acquainted with the Harbour, including the commanders of steamers visiting the port, are without exception in favour of closing the eastern opening and substituting an entrance at the north-east corner. But the numerous opinions in favor of the alternative proposal lack professional weight, and it is a pity that they are only *now* forthcoming when the work of "restoration" is on the verge of completion.

THE TRIAL TRIP OVER THE HOOGHLY NEW BRIDGE.—The programme proposed, we believe, is for the party to take train at Howrah Station, run over the Junction at Hooghly, which will then be completed, and so over the Bridge by the down line to Naihatti; crossing over to the up line and running back to the Hooghly Town end of the Bridge, the party will land there for breakfast. After breakfast the special train and party will run back to Calcutta by the Chitpore branch line over the Port Commissioners' line and through the Port Commissioners' yard, down the left bank of the Hooghly as far as the Bridge at Tolly's Nullah, and possibly, if not too late in the day, into the new Dockyard site, where at some early period after the opening of the Bridge a corner stone of the Docks is to be laid by the Viceroy.

BENGAL-NAGPUR RAILWAY.—In reply to numerous inquiries as to the point of junction of the *new* line with the E. I. Railway, we are in a position to definitely state that this will be at Sitarampur and not Asansol. The fact is that the Sitarampur Colliery owners wanted some outrageous compensation for their land, and rather than pay it, Government decided on joining at Asansol. This, however, has brought the Sitarampur people round with a good hard twist, as they foresee that if the line does *not* join near their collieries their coal will not be used for the working of a very considerable length. Under the circumstance, therefore, they might well have given the land for nothing, or at least for a very reasonable rate instead of being afterwards compelled to lower their absurd demands. We may add that the acquisition of the land for Railway purposes does not convey mineral rights.

FINANCE COMMITTEE—PROGRESSIVE SALARIES.—The Chief Engineer for Irrigation, the Consulting Engineer for Railways, and the Examiner, Public Works Accounts, Madras, having been consulted on this subject, all agree in deprecating any departure from the rules now in force. The objections to the Committee's suggestion are—(1) that the system of progressive salaries gives the head of the office the means of rewarding deserving men and punishing the undeserving, and it is stated that the Committee are wrong in their description of the operation of the rules and in their assertion of the extreme complexity of the rules; (2) that the men concerned are generally against any change in the rules; and (3) that any saving of total expenditure must mean injury to individuals. In these views the Chief Engineer, P. W. D., concurs, but would also deprecate any change on the ground that continual alterations of the rules are objectionable, and give rise to a feeling of insecurity which is prejudicial to Government service.

Current News.

THERE were about 120,000 men employed last year in the construction of the Indian Midland Railway.

THE Jubilee fireworks for Calcutta will weigh three tons. One hundred iron mortars will be used in firing the shells.

THE Quetta Railway has now reached the very foot of the Khojak Amran range. The first engine ran into Golistan Karez on the 2nd ultimo.

THE Begum of Bhopal will commemorate the Royal Jubilee by an extension of the Bhopal water-works, at a cost of nearly two lakhs of rupees.

MR. J. J. ALLEN, Government Telegraph Department, has successfully established quadruplex working on the telegraph line between Bombay and Madras *viâ* Bellary.

WE learn that the bridge over the river Purnobhola, in connection with the Behar-Assam State Railway, is likely to be completed by the end of next month, and is to be formally opened very soon.

THE Honourable R. R. Leslie-Melville, banker, has been elected to fill the vacancy in the direction of the East Indian Railway Company, caused by the death of Sir T. Douglas Forsyth, C.B., K.C.S.I.

THE total capital required for the Bengal-Nagpore Railway, including the cost of purchasing from Government the existing narrow gauge section, is 650 lakhs; but it will only be necessary to raise a portion of this at once.

MR. F. N. THOROGOOD, C.E., Superintendent of the Madras Harbour Works, has requested the Government to accept his resignation, as he is unable to accept the view entertained by the Harbour Trustees of his responsibility to their Board.

SIR JAMES BAIN, speaking at the Glasgow Chamber of Commerce, said "India had been the most progressive country in the world. If she had roads and railways, she could supply Great Britain with wheat, cotton and other raw materials much cheaper than other countries."

THE committee appointed to inspect the Marmagoa Railway line have issued their report, which speaks favourably of the work performed by the company. The committee highly approve of the plans upon which the Railway stations have been constructed, and they consider that they might be imitated with advantage on other railways.

THE price of glass lamps and other articles used for the purposes of illumination has gone up in Calcutta between two and three hundred per cent. The demand for small glass lights is likely to be enormous. It is stated that 100,000 of these lights have been ordered for Government House, and the demand for the East Indian Railway is said to amount to no less than seven lakhs.

COLONEL LINDSAY, R.E., the Engineer-in-Chief of the Southern Mahratta Railway, is now in Bangalore, and we understand that the extension from Gubbi will be commenced within three weeks or so. It is a pity that the line is to be taken by Davangeri instead of Shimoga and its neighbourhood, through which latter tract of country alone all the traffic now passes. It is not too late even now for the Dewan to have this important matter put straight.

THE Lieutenant-Governor of Bengal has signified his intention of visiting Purneah during the first week of March next, and will open for regular traffic that portion of the Assam-Behar State Railway, which lies between Kas, a station five miles beyond Purneah station on the Durbhunga extension, and Manibari on the banks of the Ganges opposite Sahebgunge Station, E. I. R. Work is also being vigorously pushed forward along the line between Katiwar Junction and Dinagepore.

THE death of Colonel Sir E. Bateman-Champain removes a man a record of whose achievements would form a history of the Indo-European Telegraph system. His last work, performed only a few months since, was to superintend the successful laying of the new cable between Kurrachee and the Persian Gulf. The great commercial and other interests which benefit so largely by the very efficient telegraphic communication between England and India owe a great deal to the deceased officer.

IN the middle of January last year, the British Burmah Lead Company, Limited, was registered with a capital of £100,000. Its Directors were Major-General H. A. Browne, Jas. Wilson, Colonel J. F. McAndrew, Jas. Morison Burnup, and William O. Law. At a meeting of the company held on the 12th January, a report from Mr. Collins, who had been sent out to inspect the property, was read, which described the mine as valueless; and the remarks regarding Mr. Law, who appeared to have been the vendor, were somewhat more forcible than elegant: while it was resolved to wind the company up.

MAJOR-GENERAL HANCOCK'S appointment to succeed Major-General Trevor as Secretary to the Government of India in the Public Works Department must be provisional, and dependent upon his not being promoted to Lieutenant-General before the 31st March next, in which case he would have to retire. If his promotion, which is imminent we believe, is not gazetted before the 1st April, he can continue to hold on till the end of the next official year, namely, 31st March 1888. When General Hancock does go, the Government of India might take the opportunity to do tardy justice to the claims of the civil branch of the Public Works Engineers.

The Bombay Port Trustees have been called upon to say whether they intend to do anything to stop the entry of white ants into their sheds. Their Engineer reports that immediate measures are taken to exterminate the pests whenever signs of them are discovered, and that when a place is treated the ants do not return, but break out in fresh places. He admits that the ants appear to drill through lime.

The Marine authorities, Madras, have, on nautical grounds, deprecated the construction of a proposed line of Railway from Kottapatam, the seaport in the Ongole district, to Kurichedu on the Bellary-Kristna State Railway, as the port of Kottapatam is positively dangerous to vessels touching there on account of shoals in its immediate vicinity, and the expenditure necessary to ensure the safety of shipping by the erection of a light house, &c., is not warranted by the trade of the Port.

It is confidently asserted that the Madras P. W. D., where great reductions in the temporary establishments have recently been made, will not in any way suffer by reductions in the various *permanent* establishments on lines indicated by the Finance Committee; but that, on the contrary, some additions will have to be made to the permanent establishments as they stand at present. The Railway Branch especially is to have considerable augmentation, owing to the change that is to be made in its administration by which the State Railways in this Presidency now in course of survey or construction will merge into the existing Guaranteed systems.

The *Englishman* announces that the Hooghly Bridge will be formally opened by the Viceroy on the 21st instant. The ceremony was originally arranged for the 20th March, but it was thought that the union of the two railways would form an excellent Jubilee episode and vigorous efforts have been made to expedite the work. The Viceroy will cross the bridge by the first train to meet the traffic of the Hooghly Bridge, and Mr. Bradford Leslie is endeavouring to arrange for running a separate line on the west side of the Eastern Bengal Railway. The proposed line would cross the Eastern Bengal and be continued right on through Calcutta to the docks, thus connecting the East Indian Railway with the docks by a through line. The proposed line will be entirely under the management of the East Indian Railway.

In the section devoted to agricultural implements at the Dumraon Exhibition, Messrs. T. E. Thomson & Co. and Messrs. Jessop & Co. were among the exhibitors, and showed pumps, waterlifts, and ploughs. Among their competitors were the Agricultural Department and the Barrakar Iron Works. The manufactures of the latter, which, by-the-bye, under the management of Ritter Von Schwarz, have attained a great success, are noticeable for their extreme cheapness. The works, for instance, turn out a plough for Rs. 3-8, and the pattern seems to greatly please the ryot of these parts, for some forty of the ploughs have been sold at the Exhibition. Another manufacture from the works, two styles of waterlift, priced respectively Rs. 35 and Rs. 100 also found purchasers in large numbers. In connexion with this department, ploughing matches were arranged before the Lieutenant-Governor, and the opinion of the numerous gathering of natives who looked on with great interest, seemed to favour Messrs. Jessop and Co.'s plough. The official award will, it is believed, confirm this view, but it has not yet been declared.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

THE INDIAN ENGINEERING COLLEGES.

Sir,—Should no more worthy correspondents come forward to correct the little inaccuracy which has crept into your comments in your issue of the 29th January, on the memorial of the alumni of the Indian Engineering Colleges, I trust you will, in justice to these men, give me space to make a few remarks on the conclusions you have arrived at on perusal of that document. You have said that "they (the memorialists) take exception to the recruitment of the service by Cooper's Hill graduates ignoring the fact that the latter have had rare opportunities which their Indian brothers have not enjoyed, *viz.*, profiting by the teachings of the triumphs of Engineering skill at Home." The memorialists certainly take exception to the recruitment of the service almost wholly from Cooper's Hill, but I am unable to find out that they have anywhere ignored or endeavoured to ignore the fact of the Cooper's Hill graduates having had exceptional advantages to profit by the numerous works of Engineering skill at Home. Since economy is always urged by Government as an excuse for the non-employment of the Calcutta graduates in Engineering, the memorialists in paragraphs 6 and 7 (which have probably given rise to these adverse comments) simply discuss the economical aspect of the question of Cooper's Hill *versus* Calcutta graduates, and endeavour to make out that a larger employment of the latter agency in the Engineer grades will tend to economy without impairing the efficiency of the service.

As regards "profiting by the teachings of the triumphs", &c., I am quite safe in saying that any Executive Engineer of the P. W. D. who has had Cooper's Hill graduates under him will tell you that when they land on the shores of India, they bring with them very little of the "profit" from Home. As matters now stand in the D. P. W., it seldom falls to the lot of an Assistant Engineer to design works, make calculations, determine dimensions, elaborate details on paper, or to plan any work according to his own ideas. These are mostly done by the Executive Engineer, to which grade the Cooper's Hill graduates need not expect to rise, under the existing circumstances, in less than eight years. On their arrival in this country they find they have much to learn which is not Engineering in one sense, but the highest type of Engineering in another. For instance, they find themselves called upon to control native work people, to look after accounts, to find out the best means of transport, to purchase materials at the cheapest market, to consider wages, in short to attend to a thousand and one administrative details which foreign youths trained in a foreign country know nothing about. I have not the slightest desire to disparage Cooper's Hill graduates. They are indeed the "best Engineers" that can be turned out from a college, or developed in libraries; they are very good draftsmen, fair mathematicians, and some of them very good scholars; but as for "profiting by the teachings of the triumphs of Engineering skill at Home" is concerned, they are considerably below the mark of the old "Stanley Engineers" who used to be selected by public competition for service in India. The memorialists do not find fault with the Cooper's Hill men. What they urge is, that if the Government does not at once see its way towards abolishing the College as being costly and unnecessary, it should break down the monopoly now enjoyed by it, of supplying recruits for service in the D. P. W. and give the Indian Engineering College graduates a chance of a career in the Department.

1st February. B. B.

Literary Notices.

Gangaram's Slide Rules.

We have received a set of these Scales, which are as ingenious as a device as they are correct in principle. Their novelty lies as much in the variety of their application as in their arrangement for giving results which are, practically, identical with those obtained by calculation. They are a development of graphic methods in Applied Mechanics in every way worthy of the attention of the Profession, and we feel sure that their general adoption is only a question of time. The Illustrated Pamphlet of Instructions, which accompanies the Instruments, shows several examples worked out, from which it will be at once seen the saving in labour that must accrue from the use of these Scales. An additional recommendation to their adoption is that while mathematical processes involve a liability to arithmetical error, they are free from any chance in this respect.

By the help of these Slide Rules, scantlings of timber for beams and trusses can be easily and readily obtained. Practical questions connected with the design of retaining walls and similar structures can be solved at a glance by the same means, which are equally useful for determining strains on girders or for corresponding results for kindred purposes. From the accuracy of the results, there can be no doubt as to the immense saving of time and trouble that can be effected by the use of these instruments, which are sold separately or in full sets. They are designed and patented by Lala Ganga Ram, Assoc. Mem. Inst. C. E, Mem. Inst. M. E., Ex. Eng. P. W. D. Punjab, who might well say: "Calculate no more—Engineering Formulæ Solved mechanically"!

The Scales are on view at the Office of this *Journal*.

A Treatise on Surveying Instruments and Surveying. *By Rai Bahadur Kunhya Lall, M. Inst. C. E.* Lahore: The New Imperial Press. 1886.

This treatise, which is designed for the use of Native Surveyors and written in Urdu, was first published in 1853. It may therefore not inaptly be called the pioneer of technical manuals of its kind produced in the vernacular for the especial use of those Natives of India who, without any acquaintance with the English language, are frequently called upon to qualify themselves for Professional employment. Although the Third Department of the Thomason College, was founded with the object of meeting the wants of this class, still there are many who cannot avail themselves of the benefits of the Roorkee Institution, and for these the work under notice should prove invaluable. Considering that the present edition—the third—has had the advantage of the author's leisure consequent on retirement from official life, the book should prove more valuable and useful than before. It is, we are glad to find, in every way worthy the author's repute and as moderate in price as excellent in quality.

General Articles.

SIRDAR'S MANSIONS, BOMBAY.

We [illegible] views of the central block of residences now being erected in Bombay at the cost of Sirdar Diler Jung, C.I.E., Bahadoor. These buildings, to be called the "Sirdar's Mansions," are being erected on a plot of ground immediately opposite the Yacht Club. The ground rent being extremely high and the lease extending for only 50 years, makes the problem a difficult one as a speculation.

The chambers will consist of 39 sets of single-quarters each containing a sitting-room, bed-room, dressing-room and bath-room, and 20 sets of married quarters consisting of a sitting-room, (capable of division), a bed-room, two dressing-rooms and two bath-rooms.

There will be servants' quarters and stabling in the rear of the buildings.

Mr. Chisholm, who is the architect, has selected as the style an adaptation of the half timbered work common to Bombay and other parts of Western India—a style undeniably suited to the climate, and not wanting in picturesque and elegant features.

TECHNICAL INSTRUCTION.

To THE VERY REV. A. NEUT, S. J.

"DEAR SIR,—I have to thank you for a copy of your pamphlet on Technical Education. In the necessity of establishing technical schools where a literary training would of necessity be relegated to a strictly subordinate place you appear to be no believer. You uphold on the contrary the supposed value of a literary training as pre-eminent over all other systems of instruction.

Let it for the moment be agreed that a literary training is more educational in the highest sense than is any other kind of instruction. Still we gain no help towards allaying the anxiety with which our statesmen are now beginning to look towards the future of India.

In some countries a man is not permitted to marry till he has shown himself financially equal to bearing the probable expenses. Even in England, where such useful legislation has not yet been attempted, there are other restraints at work. For instance, as the price of the loaf rises marriages become less numerous. But the average Hindu descries no connection whatever between the price of his *dál bhát* and the prudence of postponing his nuptials. This utter heedlessness working in the Pax Britannica must prepare grave difficulties for the future. We know that a given tract of land will not yield double the produce simply because a double number of human beings who dwell upon it put a double labour into it. This imperfect elasticity in the natural food supply of a country shows that mere agriculture in a given tract and the indefinite multiplication of human beings on that tract cannot promise a permanent equilibrium.

Moreover, India is now silently passing through a vast industrial transformation. The increase of commerce with Europe and the development of railways in India are preparing this transformation. Commerce may bring to the people of this country articles of comfort or luxury. *En revanche* it takes vast quantities of food out of India. Thus India is ever drawing nearer to the whirlpool of European struggle and stress. Before we are swept within the vortex have we no preparations to make?

Whether a country raises just the food that it needs for its own consumption, or whether it buys a portion from abroad, or whether—as now with India—it sells some part of its produce—is, comparatively speaking, a matter of secondary importance. But whatever it wants from abroad it must be able to purchase, for there is no International charitable association to give out-door relief to a people. And a moment's reflection will teach us that a country cannot make its purchases with rupees. Its purchasing power must consist of articles which are quickly consumable and quickly consumed that there may be a market for more.

Again, whatever in a country is made strictly for home consumption may be made as coarsely as the want of taste, or the easy contentedness of its inhabitants, may be willing to accept. But what is made for exportation—what is meant for purchasing power—must be made just as good—with due reference to price—as the article is made elsewhere. Thus we are driven to the conclusion that India must improve and broaden her technical skill that so against the rest of the producing world she may fight upon equal terms.

Surely before we offer to the masses the dainties of a literary *ménu* we should put strong tools in their hands to gain them their daily bread. But—you argue—a literary training has this peculiar excellence that it prepares the way for all other. To this it seems sufficient to reply that a horse must be exceptionally good if we may start him on a preliminary canter in one direction when he is expected to win a race in another. For the ordinary quadruped it seems safer to pound away from the first along the very road where the goal of his efforts is seen.

A very clever man will learn Latin and Greek so well that his intellect is sharpened or his taste cultivated and artistic skill may ensue. But the ordinary man will never learn Latin and Greek so well that his intellect is substantially strengthened. Still less will he learn his Latin or Greek so well as to have his emotions touched. For this ordinary or average man, who makes the seventy per cent. or upwards of the men of every country—let him find out early what he has to do and let him forthwith gird himself to do it.

All other cultivation of his faculties—all efforts at 'Sweetness and Light' must be made incidentally. His family life and his citizen life may do something towards making him better than a mere machine. How much these world-wide influences will be able to effect; and how, not only during the youth of the workman, but also throughout his maturer years we may bring supplemental agencies to bear—these are questions worthy of great consideration. But first of all for the mere machinery an adequate provision must be made. It is this broad question which now stretches across the road on which India is moving to her future.

Yours faithfully,

A. EWBANK.

MINING INDUSTRIES OF BURMAH.

VERY little progress has been made during the past year in the development of the mineral resources of this province, owing to the disturbed state of the country.

There are large workable deposits of coal in the Mergui district, but the country being so thinly populated, unhealthy and some distance from the Tennasserim river, no attempts have as yet been made to work these deposits. In Thayetmyo prospecting for coal is continued, but as yet no success has been attained. Any way, under present circumstances, the coal could not be brought to Rangoon at such a cost as to compete with that imported. The price of English coal at Rangoon is from Rs. 15 to 18 per ton. Good coal is found in Upper Burmah, but nothing up to the present time has been done to work the deposits.

Rich deposits of tin are to be found in the Mergui district, and are from time to time worked by the Chinese, but for some reason or other they do not appear to work it so successfully as in the Native States adjoining, although the Government protect them: during the past few years as much as 10 per cent. was taken off in the export duty, and the only conclusion that could be arrived at, by comparison with the success attending the miners in the Native States is, that they are bound down more like slaves; whereas those under the British Government are free to work as they like.

Mr. Law of Moulmein has obtained a license for prospecting for lead in certain hills in the Salween valley, and another gentleman from the same place has taken out a license to prospect for antimony in the hills within seven miles from Moulmein. The latter has been so far successful, and has obtained some 80 tons of ore and forwarded the same for valuation to England.

GINE

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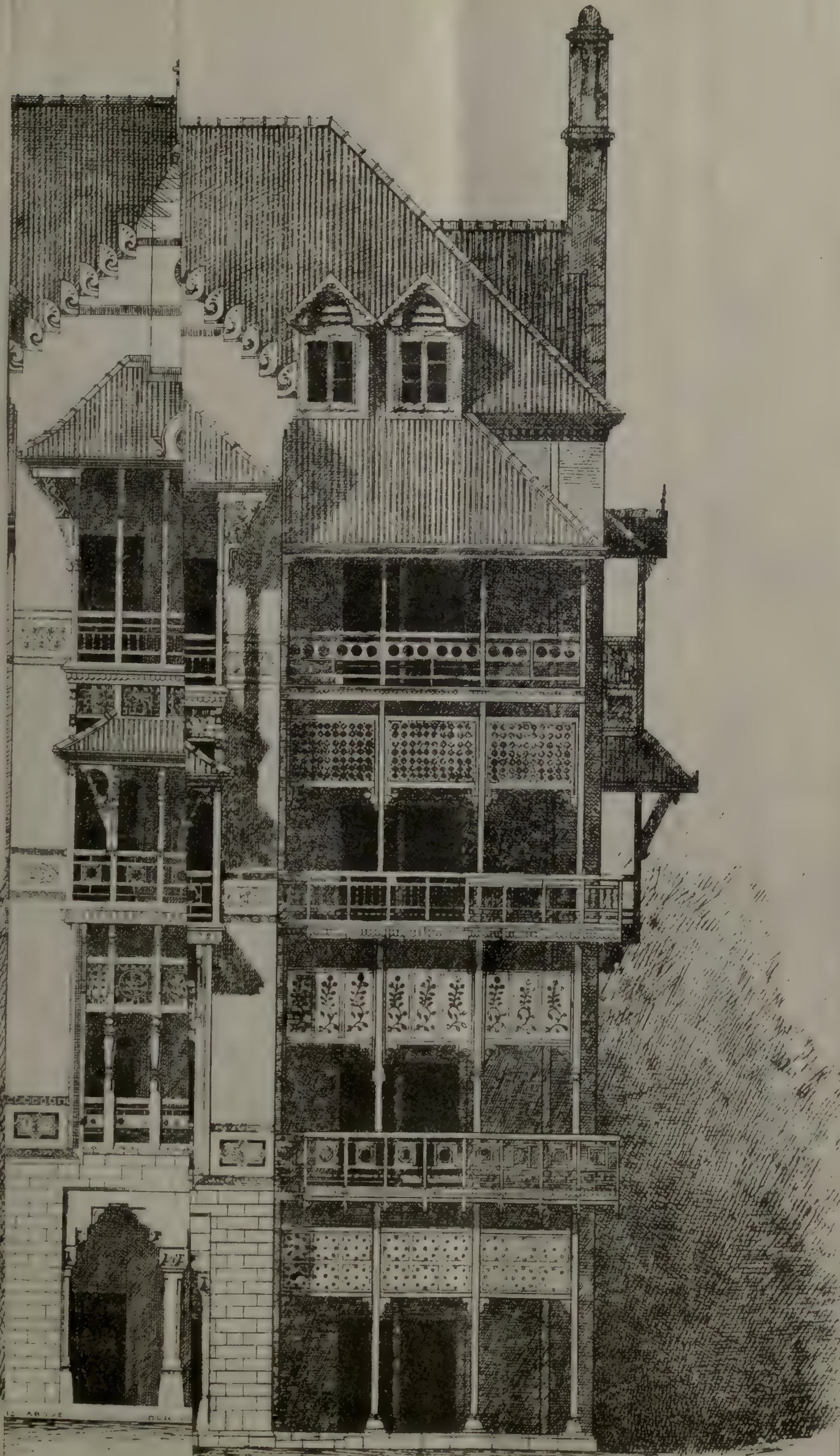


AN INCH

Burmah will yet hold herown in regard to earth oil production although the venture of the Boronga Oil Company has ended very unsatisfactorily in Akyab; still we hope to see that when the resources of the oil wells of Yaneen Goung are developed, that it will compete with the American importation. The wells in Yaneen Goung are from two to three hundred feet deep, and the oil is collected daily, being scooped up in earthen pots. A company is, however, now getting out plant and machinery to pump the wells on a scientific principle.

In Arracan, where the oil wells have been worked by the people some hundred years back in a primitive manner and are still worked on the same principle, the produce is crude or mud oil. Oil extracted from the Kyouk-Phyoo wells is very clear and can be safely burnt in English lamps without refining. This oil always commands a good price in the local market; as much as 40,000 gallons a year have been exported from Kyouk-Phyoo. Six years ago, concessions were given to one Mr. Savage, also to an English Company, for working of oil wells on the Boronga islands near Akyab. Mr. Savage, who started first, gave it up, but worked his wells on the Kyouk-Phyoo island by means of hand-pumps, and extracted about 200 gallons daily from two wells, averaging a depth of about 130 feet. The appliances used both by Mr. Savage and the native workers were rude, and they barely raised 50,000 gallons during six months of the year. The Boronga Company, however, sunk some 5 lakhs of rupees in their venture, and imported six experienced Engineers, workmen from the Canadian oil fields, with improved machinery for boring and raising oil; also refining machinery which they erected on the spot. One of their wells was sunk as deep as 1,000 feet, and for sometime it yielded as much as 1,000 gallons of oil a day; however, through some disagreement, the Company became involved, and matters are now in a very unsatisfactory state. But it is now predicted that with the improved machinery now being imported for Yaneen Goung and the extensive refining sheds under erection there that the Burmah produce will oust the American illuminant out of the local markets.

Lastly, I would refer to the recent discovery of gold found in the Merza valley, about 130 miles north of Mandalay. The result of the analysis made by the Chemical Examiner shows:—

Gold	87·66
Silver	5·96
Copper pyrites	1·95
Silver do	1·54
Magnide	0·32
Quartz	1·09
Loss on ignition	1·48

Specimens were found in large, irregular grains adhering to quartz, silver being partly alloyed with the gold.

In connection with the analysis of the gold, a brief notice of the gold-digging in the Katha district may be of interest, it is abstracted from a report by Mr. H. M. S. Mathews, Assistant Commissioner of that place.

"There are three different methods of working:—

"*1st.*—Shallow channels are dug in the gold bearing deposits with deeper pools at intervals to serve as catching basins; water is then conducted into the channel from the nearest hill stream; after a few hours the water-supply is diverted and the water baled out of the basins; the silt collected in these being carefully washed for gold dust.

"*2nd.*—By washing the silt collected during the rains in deep catchment drains, sometimes $1\frac{1}{2}$ miles long. These yield Rs. 5 to 20 weight of gold in one season.

"*3rd.*—By mining the auriferous layers in the deep alluvial deposits. The layer is generally a span or less in thickness, of dark sandy pebble soil, overlaid by a red layer of similar composition, which is again overlaid by ordinary loam from 5 to 20 cubits in depth. In the dry weather, drifts are driven from the bank of a stream, on the outcrop of a gold layer, at intervals of about 7 or 8 cubits; a shaft is sunk down to the drift apparently to secure escape in case of a fall of earth; the drift is then continued in the most promising direction. The earnings are very uncertain—Re. 1-4 weight of gold to 4 annas weight a month. At the diggings the gold is valued about Rs. 20 per rupee weight, at Katha the price is Rs. 20 to 30."

The gold seekers only work two or three months a year, the remainder of their time being spent in agricultural pursuits.

H. T.

DINDIGUL WATER-SUPPLY.

The town of Dindigul is 270 miles from Madras situate on the South Indian Railway in the Madura district. The town has always borne a repute for abundance of good water, till of late years, and now the authorities are exercised in finding a source of supply that will yield water that will come up to the standard the Sanitary Commissioner considers necessary for potable water.

The well from which it was at first proposed to supply the town is in the bed of a well known and long existing tank, of the usual revetted type, where experience and surrounding circumstances point strongly to a good supply being available. The Superintending Engineer, referring to the unfavorable results of the analysis of the samples of water taken from this well, favors the opinion that the water has not been properly tested yet, because the well has never been pumped dry on account of the pulsometer hitherto used not being sufficiently powerful. It seems that at first the lining of the well was not raised high enough to prevent the tank water submerging the well when the water in the tank rose rather high, and that the samples were taken while the well was in this state. Afterwards, a parapet was built all round on the top of the lining, so now water from the tank cannot enter except by percolation, if this is possible. But the well was not pumped dry before the parapet was built nor since, and, consequently, subsequent samples were taken, when circumstances were practically the same as when the first were taken. For this reason, Mr. Crighton, Loco. Superintendent, S. I. Railway, considers the best water available has not been obtained yet, and the Superintending Engineer agrees with him. Mr. Crighton suggests that the well should be pumped as follows:—Pump the water until the depth on floor is nine inches, which is the least depth that will suit the pulsometer; then allow water to rise 10 feet; then pump it out until depth is reduced to nine inches; let it rise again 10 feet and then pump again, and so on for ten days. At the end of this time, take samples when the water is nine inches deep and after it rises to full height, that is, the height it will rise to if pumping is stopped altogether. If this experiment is carried out properly, the water at the end of ten days ought to be free from local impurities at all events, and the then quality will, it is believed, represent very fairly the true working quality of the water.

The experiment will give also data for determining whether the well is likely to be able to supply the town, for if the length of time it takes to pump water out until the depth is reduced to nine inches is known, as well as the time the water takes to rise ten feet, it will be an easy matter to calculate the rate of inflow to the well and quantity of water taken out.

The Superintending Engineer is not hopeful that better water than that of the well in question could be found within a reasonable distance of the town, and condemns the scheme to bring a supply from the Kodavanar river. He says that—the distance from the town to the river is $4\frac{1}{8}$ miles. "A six-inch diameter pipe is the smallest it would be advisable to lay. Mr Crighton's estimate for a pipe of this size delivered in the town is Rs. 1-12-0 per foot run. To this should be added the cost of carting to site, leading, and laying, which would probably bring the cost up to Rs. 2 per foot run. Four and one-eighth miles are equal to 21,780 feet. So the cost for laying a six-inch pipe would amount to $21,780 \times 2 =$ Rs. 43,560—a sum which is beyond the means of the people or municipality." Moreover, from levels furnished by Mr. Target, Executive Engineer, to the Chairman, Municipal Council, it seems the bed of the river is 93·59 feet below the parapet of the well, while some other levels taken show the height from the parapet to the rock selected for a site for a service reservoir is 80·47 feet, which makes the reservoir site 174 above the bed of the river. To pump water to a height of 174 feet and drive it $4\frac{1}{8}$ miles would, of course, require a powerful pump, and considerable expense in the way of fuel. He adds: "Again, it may be asked whether water might not be brought from the river in either an ordinary earthen channel or in a masonry one. This cannot be done, for the country from the town to the river falls or slopes towards the river. Besides, the bed of the river is a considerable depth below the adjacent ground, and therefore a supply could not be obtained unless the water is raised by some artificial means. Taking all these circumstances into consideration, I think the conclusion is that the scheme to bring water from the Kodavanar may be abandoned, for it is impracticable on account of the great outlay it would involve."

L. F. E.

LIGHT IRON BRIDGES FOR DISTRICT ROADS.

MR. ANDERSON's plan of replacing wooden bridges by cheap but permanent structures of iron is by no means a new one. Excepting where the temperature is dry and the variation in 24 hours small, wooden bridges will decay very rapidly. A quarter of a century ago, or perhaps more, the northern districts of the N.-W. P. and Oudh were provided with a large number of wooden bridges, because, firstly, sufficient funds were not available for a large number of permanent structures, and, secondly, sâl timber was exceedingly cheap. Hence a number of cheap bridges were built up to meet the wants of a portion of the country which was changing rapidly from a state of jungle to a condition of great agricultural prosperity. These bridges as they decay—they are never swept away—are replaced by permanent but cheap masonry or iron structures.

From what can be gathered from Mr. Anderson's report, it appears that the disappearance of so large a number of bridges is not due entirely to the quality of the material with which they were constructed.

The timber bridges in the N.-W. P. and Oudh *last their time*, and when *decay commences* it is chiefly in the lower parts of the piles and the planked roadway. These defects, *in the commencement*, are rectified at a small annual outlay, until decay becomes *rapid* and *general*, when it is found cheaper to build a new bridge altogether.

Annexed are sketches of light iron bridges for district roads—Nos. 1 and 2. The plans are so simple, light and economical, that a detailed description of either is unnecessary. They can be made up at Bombay or Calcutta. The cost of one span complete at Bombay or Calcutta would be in round numbers about Rs. 1,650. In streams in which the velocity is high, as is the case in nearly all streams in districts bordering the Himalayas, this style of bridges is eminently suitable for reasons "clear as day" to the Engineer.

We have standard designs for Provincial Civil Buildings, and many are of opinion that Government should insist on Local Boards adopting standard designs for Bridges. A case might be instanced where a sanctioned plan and estimate for an iron bridge of 3 bays of 60 feet each and 12 feet roadway has cost over Rs. 50,000. The locality where this bridge is built could be very easily crossed by a light but strong iron structure *with a* 16 *feet roadway* for less than *half* that sum. R.

RANGOON DRAINAGE PROJECT.

(Continued from last issue.)

SPECIFICATIONS.

Sand.—The sand must be clean and gritty. If ordered, the sand must be carefully washed, without extra charge.

Bricks.—The bricks must be the best quality made obtainable in the district. They must be hard, well burnt, and true in form, and free from cracks and flaws of every description.

Cement.—The cement used must be the best Portland cement, weighing not less than 112 lbs. to the bushel.

Brickwork.—The brickwork must be in the old English, or such other bond as may be ordered from time to time. The face joints must be struck with the trowel as the work proceeds. The workmanship must be of the best quality, and the joints must not exceed one quarter of an inch in thickness. The mortar used is to be composed of one part cement to three parts fine sand. The mortar must in all cases be used fresh. Breaking up set mortar and retempering will in no case be allowed.

Concrete.—The concrete must be composed of clean sharp sand and clean gravel, or broken stone, and gauged in a box of approved shape and capacity, and thoroughly well mixed with the cement, so as to form a solid mass free from internal cavities. The largest stone must be able to pass through a 2-inch ring; and in order that the concrete may form a solid mass the size must vary from the smallest gravel to the maximum size. The concrete must be made with Portland cement gauged, one part cement to six parts gravel. The required quantity of cement must be gauged in a box, whose depth is not less than that of its greatest width.

Timber.—The timber used must be of first-class quality, free from knots, shakes, sap, and flaws of every description.

Cast-Iron.—The admixture of metal used in pipes and other castings shall be such as will produce tough, clean, sound, and strong castings, not brittle, but such as may be easily chipped or drilled. It must be capable of standing a tensile strain of 5 tons to the square inch without breaking. The whole of the castings to be dipped in Dr. Angus Smith's Composition at a proper temperature and in a proper manner previous to leaving the founder's yard.

Wrought Iron.—The wrought iron must be of the quality known as best Staffordshire bar iron and must be capable of standing a tensile strain of 20 tons to the square inch without breaking.

Painting.—The paint used shall be made of the best boiled oil and red or white lead, according to the colour required, and the best turpentine and driers The ingredients must be thoroughly mixed and the paint applied in a thoroughly workmanlike manner, and all woodwork where ordered painted with three coats.

Sewers, Sewage-Mains and Air-Mains.—The sewers, sewage-mains, and air-mains are to be cast-iron pipes, of the sizes and thickness and laid at the necessary depths in every case. They are to have socket joints, which must be thoroughly well set up with yarn and pig lead and made perfectly air and water tight with proper setting-up tools. The depth of the lead joint must in no case be less than two inches. The pipes must be cast vertically with the socket downwards and must be true in form and have smooth surfaces. They are to be coated with Dr. Angus Smith's Composition after being first heated to a proper temperature for this purpose. All the pipes must be tested to stand an internal pressure of 150 pounds to the square inch.

Man-holes and Ventilators.—The man-holes with ventilating gratings must be built at the places shown in the plans, Sheet No. 1. In situations where the subsoil water rises above the level of the brickwork a coating of cement gauged, four parts cement to one part sand, three-quarters of an inch thick, must be put between the rings of brickwork and the surface, trowelled perfectly smooth.

Ejector Stations.—The Ejector Stations are to be constructed of cast-iron tubing, in accordance with the details shown in the drawing, Sheet No. 3. The faces are to be truly planed, and ¾-lead piping (6 lbs. per yard) used as jointing material, so as to make a perfectly water-tight joint.

Ejectors.—The Ejectors are to be of cast-iron, each of 200 gallons capacity; there are to be two Ejectors at each station, the second being a duplicate. A general form of Ejector Station is shown in detail in the drawing, Sheet No. 3.

Night-soil Depôts.—The night soil-depôts are to be constructed of iron, in accordance with the design shown in the drawing, Sheet No. 4. The pillars are to be of cast-iron, the sides of plain sheet, and the roof of corrugated iron. The whole of the ironwork is to be either galvanised or subjected to the Bower-Barff process.

Ventilating holes are to be provided in the sides all round from ground level to the height shown on the drawings, and Aldon's Patent Exhaust Ventilator fixed in the roof. The cistern for the reception of the contents of the pails must be raised above the ground level to the height shown. Proper gratings must be fixed at the outlet and water laid on for flushing.

The floor is to be made of concrete rendered smooth on surface.

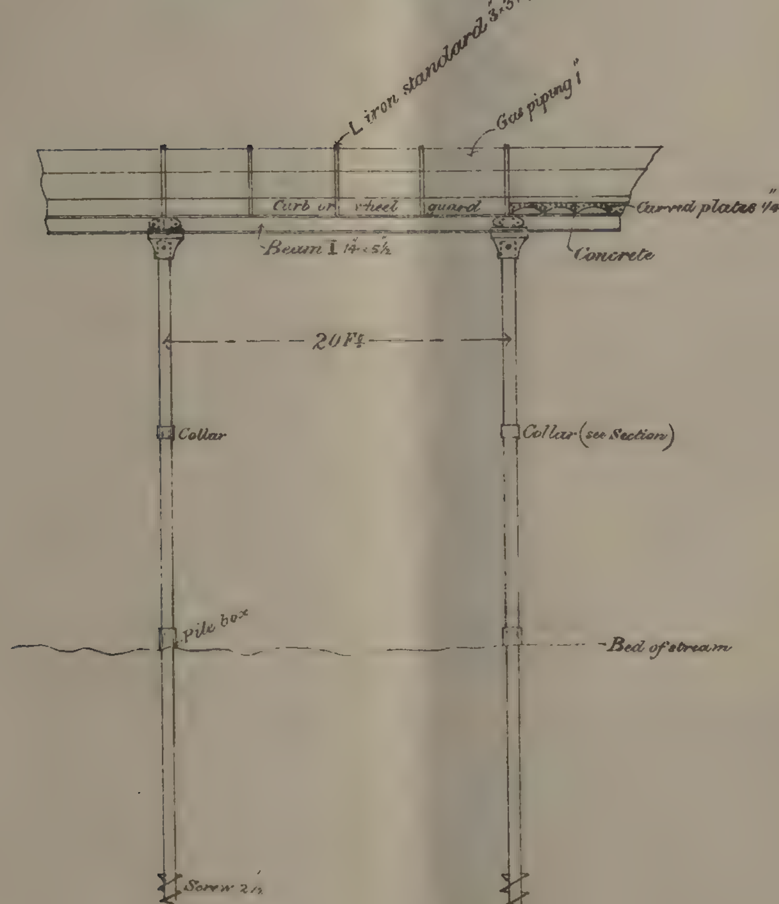
Sulliage Water and Lavatory Sinks.—The depôts are to be of cast-iron, the brickwork foundations fixed in the rear of the houses, as shown in the drawing, Sheet No. 2, in pairs, one sink to each house. They are for the reception of house slops and to be used as lavatories. The details are also shown in Sheet No. 2, figs. 1 and 2.

Flush Tanks.—Shone's Automatic Flush Tanks are to be placed at the heads of the sewers in the position shown in the drawing, Sheet No. 1. They are to be formed of three-feet double spigot cast-iron pipes, having special casting ends, to which are attached the syphon and automatic mechanism which are to be supplied with water from the water-mains. The flush tanks are shown in detail in the drawing, Sheet No. 5. They are connected with sewers gravitating to several Ejectors which meet together at one point. At this point three-way sluices are to be fixed for diverting the flush water along one set of sewers only at a time.

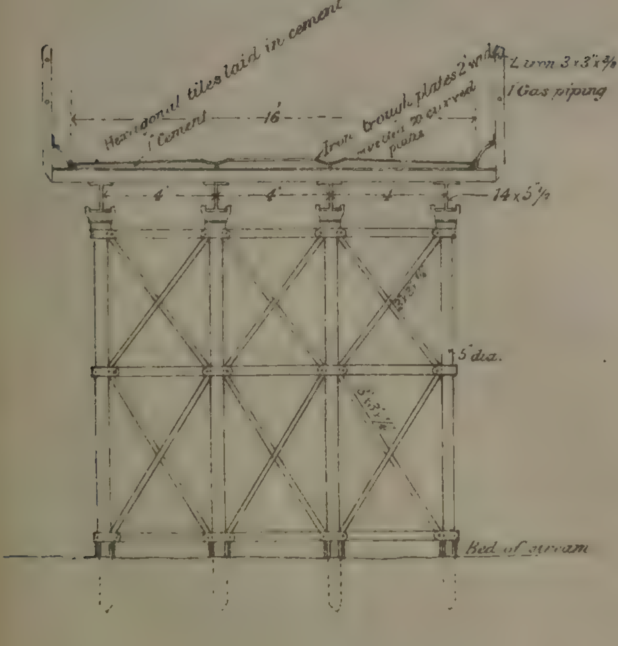
LIGHT IRON BRIDGES

FOR DISTRICT ROADS.

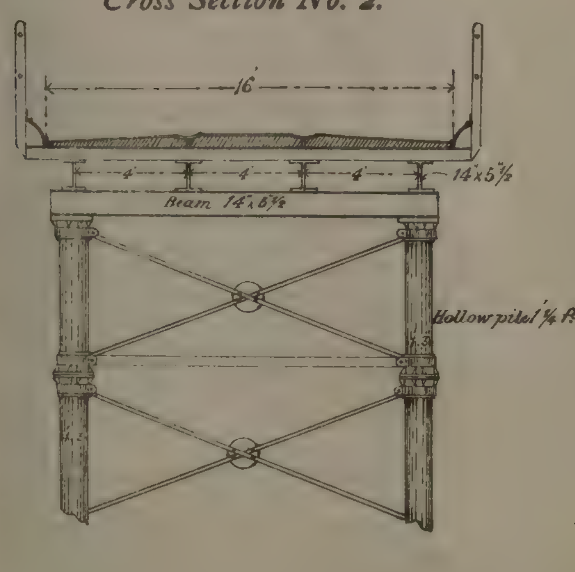
Elevation of one Span of 20.



Cross Section No. 1.



Cross Section No. 2.



The "STAR" Press, 19, Lal Bazaar, Street, Calcutta.

Water-Supply.—For the purpose of increasing the pressure in the mains, the water is to be forced into these by Ejectors situated close to the proposed filter beds. These Ejectors, three in number, have to be of specially large size, in order to keep the pressure in the mains continuous. These Ejectors are therefore to be made of wrought-iron, such to be 6 feet internal diameter and 12 feet 6 inches long. The capacity of each will be about 2,000 gallons, two being sufficient for the work, and one a lie-by.

The sides of the Ejector House are to be of brickwork, and the roof of corrugated iron. The details of these Ejectors and the Ejector House are shown on drawing, Sheet No. 6.

Workmanship.—The whole of the works comprised in this Specification or referred to in the accompanying drawings, and all work connected therewith, to be prepared, carried out, and completed in a thoroughly sound and workmanlike manner, to the entire satisfaction and under the control of the Engineers.

(To be continued.)

REPORT ON THE AURIFEROUS TRACTS, MYSORE.

No. II. Section—Kolar Gold Fields.

(Continued from page 57.)

This section of the field commences on the North of the Palar River, 1½ miles North of the Kolar-Mulbagal road, and in a direct line about 6 miles from the town of Kolar. It is divided from No. I. or South section by the Mulbagal granite which crosses the country here East and West, its breadth being about 8½ miles. In several places in this granite are to be found trap and hornblende schist carrying large quantities of iron. This mineral has been worked for in two places by native iron smelters of the surrounding villages. The Palar River flanks this No. II. section of auriferous ground to the South, forcing its way through a very heavy alluvial deposit which is to be seen on both banks during the dry season. The ryots (farmers) here dig large deep ponds in the bed of the river during the dry season to obtain water for sugarcane cultivation. I have seen these ponds sunk to a depth of 50 feet and the bed rock had not been reached. The native gold washers work in this alluvial deposit during the very dry season of the year (March and April) and obtain sufficient gold to give them a livelihood and this from the surface only, as they never remove the soil for more than 3 feet deep. The farmers or ryots who sink these ponds have the lower portion of the deposit from them washed by the professional gold washers. I may remark here that the Hindus or higher caste people in this part of the country do not wash for gold, nor did they mine in the ancient times; the whole of this work being done by the lower or Pariah caste, while in other portions of the Province that I visited, washings are made by the Jalagar, a low caste Hindu. The auriferous portion of the country here rises rapidly from the North bank of the Palar and stretches away to the North for about 3½ miles and about 2½ miles East and West. The whole of this gold field has been capped by a heavy iron conglomerate which has been, and is now, weathering down, giving the country the appearance of a small mountain range running North and South for a distance of about 2 miles, its greatest width being about ½ mile with a narrow cross range from about its centre lying due East and West. This iron cap is in a rapid state of decomposition and each monsoon carries large quantities of the *dêbris* to the North and South where it is found in deposit on the flat portion of land to a depth of 6 or 7 feet. Northward, from the bank of the Palar, the country rises in gentle slopes and the country rock (chloride schist) is laid bare, exposing several very fine reefs of quartz. These reefs can be distinctly traced from South to North under the small iron cap that crosses them at right angles until it meets the Northerly range of hills. There is one very large old working and a small one in the South-West corner of this field. This section of the Kolar gold field differs in bearing from that of No. I. by a few degrees to the East. An instrument set up on the South point of the iron cap that runs North and South will give a bearing direct upon Balaghaut. Some of the finest alluvial gold is procured here by the native washers, and I have seen some of the very finest samples brought from this portion of the field and offered for sale to some of the mining Captains. One small nugget of about 4½ oz. was once offered for sale at the Balaghaut mines. During the rains, a woman will collect gold from the value of 8 annas to 10 rupees daily, and I have seen some of them gather quite a surprising quantity. This section I call "Manighatta" though known by others as "Mulbagal." Water, fuel and labour are in abundance and the climate is much healthier than in the other section of the Kolar field where mining operations are in progress.

No. III. Section—Kolar Gold Fields.

Between No. II. and No. III. sections there is a depression in the country, a valley running East and West and about 4½ miles North and South. To the North of the road leading from Shrinivaspur to Mulbagal, this section is best seen at the village of Arkara, 4 miles from Shrinivaspur. At first sight this portion of the field might be mistaken as taking its course North-West by South-East, but on examining the country rock will be found bearing about 5° East of North. Here, as in No. II. section, a long line of narrow lowlying hills formed of iron conglomerate runs almost parallel with the road leading from Shrinivaspur to Mulbagal. This line of hills in its greatest length is about 9 miles and is nowhere more than ½ mile wide. The country to the North and South of the road and for about 4 miles East and West is chloride schist interstratified with micaceous schist, and in several places large gneiss veins run parallel with the schistian rock. On the South side of this range of hills and South of the road, very few reefs of quartz are to be seen, but on crossing this range of hills to the North-East in watercourses of considerable depth, are to be found some very promising lodes of quartz. In tests I made on this portion of No III section, I found some very good samples of gold. The chloride schist or gold-bearing rock of Mysore runs North slightly East and cuts out completely upon the granite that forms the Northern boundary of the Territory at this point.

The country rock forming the zone or belt of auriferous country from Mallappakonda on the South to Hodali on the North is chloride schist slightly interstratified in places by gneiss. There are a few trap dykes running parallel with the strike of the country North 10° West. These dykes upon close investigation will be found not to extend downwards. The general bearing of the field is about 350° with its dip to the West varying very little at any point in the dip or general bearing.

(To be continued.)

NOTES FROM HYDERABAD (SIND).

The District Boards of Kurachee and Hyderabad—jointly—have ordered a new steamer to ply on the river Indus, between Kotri on the right bank, and Gidu Bunder (opposite Hyderabad) on the left bank, as a ferry. The new vessel will be a duplicate one, as the present steamer has to run every day consecutively throughout the year, and some inconvenience is felt if any delay occurs caused by accident to the machinery. Having a duplicate vessel at hand will prevent any great inconvenience in this way. The principal dimensions of the new steamer are: Length between perpendiculars 110′ breadth 22′ extending to 26′ beam at deck, depth 5′. The engines on the compound non-condensing principle, with side paddles. Speed 10 English miles per hour. The specification was drawn up by the Local Boards Ferry Superintendent Mr. Bayliss, and the contract has been placed in the hands of a promising young engineering firm (Messrs. McKenzie and Co. of Kurachee). The vessel will be built of steel at Birkenhead by the eminent firm, Laird Brothers. The Messrs. Laird will build, and have the vessel ready for an inspection trial in three months from date of order, which has been telegraphed, after which she will be taken to pieces and sent out, for re-erection by Messrs. McKenzie and Co. on the river bank at Kotri, under the inspection of the Ferry Superintendent, and she is to be handed over after trial on the Indus, early in July. The contract for this vessel has been given for Rs. 72,500.

The City Municipality of Hyderabad—Sind—has ordered two plants of pumping machinery for their Water Works, through Messrs. John Fleming and Co. of Bombay. This machinery when erected will completely duplicate the three different water lifts at that station; which is, and has been, depending on its water-supply, from single machinery since the works were opened in 1878. Most fortunately during all this time the supply has never been cut off for an hour, excepting to clean out the distributing reservoir occasionally. One plant of machinery for the same works, to duplicate the heaviest lift, at the Fort, was ordered in June last, and is expected shortly.

Great preparations are being made to do honour to the Queen Empress of India, on Jubilee day; the Municipalities and the general public, are unitedly working with a will to celebrate this great day in a most loyal manner.

J. B.

THE BOLAN RAILWAY NARROW GAUGE LINE.

Receiving a few days' leave for Christmas, I determined to spend it out of Quetta, and my way led me over the metre gauge line down the Bolan Pass. Perhaps a short account regarding this line may be of interest to your readers.

The length of the line is nearly 10 miles, and the sharp curves with heavy grades form one of its main features. Curves of 200 feet radius on a grade of 1 in 23 occur in several places, and the whole line is one series of sharp curves. The train is not off one before it is on another, and its progress through the gorge has been compared not inaptly to a skater cutting figures on the ice, as he leans over first to one side and then the other. The only engines and waggons that can be used are on bogies. The Fairlie engines are run without their tenders to save weight, and as a consequence watering stations are placed very close together. The load for one of these engines is 2½ waggons each, having a carrying capacity of 15 tons each, and a train generally consists of two or three engines with their loads. The engines and waggons are provided with Westinghouse brakes, thus ensuring the safety of the train.

Another novel feature is the arrangement for the conveyance of 5′ 6″ gauge rolling-stock over the line. The idea is that of a young Cooper's Hill Engineer, and is effected by special bogies contrived to receive the axles of the B. G. vehicles and lift them off their wheels in the following manner:—The bogies are first run into a pit, something like an ordinary ashpit, but with a ramp on one side to lead to the floor along which the metre gauge line runs, while the broad gauge runs on the top. The bogies being ready, a B. G. vehicle is run over them and its axles clamped on to the V which is fixed on top of the frame. One bogie is required for each axle. When ready, the bogies are drawn up the ramp and the waggon is lifted off its wheels on the M. G. bogie. In this manner a number of locomotive waggons and carriages have been transported to the broad gauge line beyond. Admirable as the arrangement is for the transport of empty vehicles, however, the extra dead load and its top-heaviness make it objectionable for the conveyance of loaded ones, and the break of gauge has been found so troublesome, and the carrying capacity of the metre gauge so insufficient, that a survey for a broad gauge line to be constructed on the Abt System has been ordered.

J. C. B.

NOTES FROM HOME.

(From our own Correspondent.)

It appears from the report of the Registrar-General that the London Water Companies have furnished him with the average daily quantity of water supplied during the month of November 1886. According to their returns 157,663,668 gallons were supplied daily or 219 gallons to each house and 28·1 gallons to each person against 27·7 gallons during November 1885.

There are now 865 miles of tramway line in this country as compared with only 269 in 1878 and 752 in 1884 and the total capital paid up stands at £14,323 per mile against £15,000 eight years ago and £14,500 last year. The average cost of the Railways of the United Kingdom is about £42,000 per mile compared with £14,323 for the tramways. Of locomotives there are now 452 standing at £572 per engine whilst the 3,410 cars cost £170 each.

In a paper on "Electric street cars," Mr. T. C. Martin gives particulars of the various systems of electric street cars run in America concluding with the system of storage, and he understands that storage is to be extensively used at an early date by the North Metropolitan Tramway Company. At Antwerp the Julien electric storage car took the first prize and the car has since been tried at Hamburg with very satisfactory results.

The enormous power of Niagara River Falls is to be utilized by constructing a subterranean tunnel from the water level below the Falls about 200 feet under the high bank of the river extending through the solid rock to the Upper Niagara River at a point about a mile above the Falls where a head of 120 feet is obtained. The tunnel thence extends parallel with the shore of the river for 1½ mile at a depth of 100 feet below the surface of the ground and at a distance of 400 feet from the navigable waters of the river, with which it is connected by lateral tunnels. The main tunnel will be circular in form and 30 feet in diameter as far up as Port Day and will gradually diminish above that point in accordance with the number of mills which have yet to empty their tail waters into it until at the upper end it will be of the same area as the cross tunnels which fall into it. Between Port Day and the upper end of the tunnel the town plat is to be laid out with streets at right angles to the main tunnel. The work will take about two years to complete and has been undertaken by the McBeen Tunnel Company who will shortly have an army of 10,000 Italian workmen on the spot. The cost is estimated at from £800,000 to £1,000,000. A careful estimate shows that the water which will pass through the tunnel will give a result equal to 260,000 horse-power or in other words is equal to over 400 factories of 500 horse-power each. Sufficient land has been secured to accommodate that number of mills.

A new light was last week introduced at the Great Iron-works at Staveley, Derbyshire, and is described as simple, economical, and possessing great illuminating power. The light is given by a large lamp which burns a very cheap oil produced at the works of Messrs. Kempson. The lamp is made to burn, by steam pressure, coal tar oils, which at the present time may be purchased at an almost nominal price. A tank containing about twenty gallons of these cheap oils, having a large lamp attached, is placed in mid air, and when the light is required the steam is turned on through a half or three-quarter inch pipe. A light is applied to the lamp, which bursts into a flame of about 2,000 candle power, and consumes somewhere about 2 gallons of oil per hour.

The Brighton Town Council have lately had under discussion the question of the foreshore and the denudation of the beach which has been going on since the erection of the new sea wall at Hone, and its attendant groynes. Strong opinions were expressed in favour of concrete groynes as eventually proving more economical than wood, and ultimately it was decided to erect four groynes of concrete on the western foreshore.

A Local Government Inquiry was opened this week at Norbiton respecting a proposal by the Rural Sanitary Authority of the Kingston Union for the formation of two special drainage districts in the Lower Thames Valley and for the sewerage of one of those districts by a scheme propounded by Mr. Baldwin Latham, the proposal being to treat the sewage by efficient chemical means combined with filtration through land, and the discharge of an innocuous effluent into the River Mole.

The Sanitary Registration of Buildings Bill, which is to be introduced in the coming Session of Parliament, was under discussion at the recent meeting of the Society of Medical Officers of Health, and it was resolved that, as the Council found themselves unable to approve the principle of compulsory registration involved in this Bill, the Society should petition against the Bill. This Bill, which is likely to throw a vast amount of extra work upon the already overworked Surveyor at no increased remuneration, will evidently meet with considerable opposition from the Association of Municipal Engineers, and the Bill is therefore likely to meet with failure. Something may have to be done in this sanitary direction, but under the circumstances it is expected that the promoters of the Bill will withdraw it for more mature consideration.

To provide for the continued increase of traffic at Clapham Junction Station a platform was constructed on the west side of the main line of the London and South-Western Railway bringing the number of platforms up to nine; but still further extensions have been found necessary, and for the purpose of the expansion of the Station between three and four acres of ground have been acquired by the company. When these works are completed the station will cover about 23 acres. The necessity of the intended extension may be imagined when it is stated that the average number of trains arriving at and departing from Clapham Junction is upwards of 1,500 being at the rate of two passenger trains every minute from 5 in the morning until midnight.

An effort is being made to utilize the 14,000,000 gallons of water per day which the Great Western Railway are now

pumping at the Sudbrooke springs on the Monmouthshire side of the Severn Tunnel and at present allowed to run to waste, while it costs them nearly £10,000 a year to pump it into the Severn Estuary. The water has been submitted to analysis, and it has been declared to be the finest spring water entirely free from organic matter and the finest water that could be desired for domestic purposes. The Mayor of Bristol lately presided over a town's meeting in favour of a scheme for utilizing this spring as a further water-supply for Bristol by bringing it across the Severn by a tunnel beneath the bed of the river.

Experiments on the use of iron sleepers are still extending. The London and North-Western Railway have a considerable length laid with Webb's steel sleepers. The Brighton and South Coast Railway Company have just laid down some length of iron sleeper road at their Croydon Station, where from the heavy traffic passing over it, it will have an exhaustive trial. Iron permanent way is not new to England, as about thirty years ago several miles of Macdonald longitudinal road was laid down on the Bristol and Exeter Railway, and although the system was not perfectly successful, it has carried the main line traffic of the Great Western Railway for that period.

The traffic receipts of the English Railways for the past half-year are on the whole satisfactory as indicating a revival of trade. The Lancashire and Yorkshire Railway Company and the London and North-Western Railway stand especially well; on the other hand the Midland Railway, whose lines extend throughout the length and breadth of the land, shows a deficiency.

MINING IN GREAT BRITAIN.

(*From our own Correspondent.*)

A SPECIAL report made by Mr. Joseph Dickenson, A.M., Inspector of Mines, upon the explosion at Bedford Colliery, near Manchester, has been issued recently. The lamps in use were Davy's, provided with shields, encircling the lower portion of the gauze for two-thirds of the circumference and from 2½ to 3 inches high. The explosion is said to have arisen at an issue of gas, at a point where a large quantity of timber was being drawn. The ignition being due to the men continuing at work and failing to report the presence of gas. One of the survivors witnessed the firing of the gas at a Davy lamp: from his evidence it appeared that the gas "blazed" in the lamp of a fellow workman who instead of attempting to extinguish it by drawing down the wick with the pricker, and with the shield down and the lamp sheltered, carefully and slowly taking it into purer air (which was close at hand); he shook the lamp and blew upon it, the immediate result was that the lamp passed the flame and ignited the gas issuing from the broken roof. Much might be done to protect men from their own wilfulness or ignorance, if some instructions were given to them upon the use of safety lamps, and if the Special Rules and the precautions upon which they are based were more fully explained to them.

It is anticipated that any new Coal Mines Regulation Bill will be more stringent than the present with regard to the use of gunpowder and other explosives for blasting in coal mines. The possibility of such enactments naturally turns the attention of mining engineers to other modifications in the methods of working coal. In one direction, attempts have been turned to invention of flameless explosives, and the quenching of the flame of ordinary explosives. The latter result appears to be best effected by the use of the water-cartridge, which is claimed by many inventors, of whom Mr. McNab appears to have the prior patent taken out in 1876. Under favourable conditions, and where the dynamite cartridge is kept suspended in water by means of diaphragms, it appears that there is almost perfect safety, owing to the absence of flame or sparks.

As regards mechanical wedging, considerable progress is being made; Hall's, Ramsey's, Burnett's and other forms of wedges are found to be effective means of detaching coal. Ramsey's wedge has proved that such apparatus are very effective in strong seams, and at a cost not greatly exceeding that of powder.

The use of the lime cartridge appears to be effective in certain coal seams, but trials in more tenacious seams appear to prove that its use will be somewhat restricted, more especially, owing to the somewhat high cost of getting entailed by its use. In addition, the shots are sometimes dangerous from the blowing out of steam or highly heated lime.

The cost of 24 hours' fog in London is estimated at more than £5,000 for extra gas alone. It appears that one of the great gas companies consumes an additional 3,500 tons of coal to produce the extra gas consumed during 24 hours of London fog.

An early report has been issued as to the explosions in coal mines during 1886. The total number of deaths was 116, and there have been only three similar years since 1850 when a less number was killed. The chief explosions are:—Reservoir colliery, Leicestershire, where ignition of gas at a naked light caused the death of two persons. The same cause resulted in the death of eight workmen at Easton colliery. The most serious explosion occurred at Bedford colliery, where 38 men were killed, owing to men continuing at work in the presence of gas. In an explosion at Bedminster colliery, 10 men were killed, naked lights being in use. Twenty-two men were killed at the Altofts explosion, which was alleged (by the verdict of the Coroner's Court) to be caused by the ignition of coal dust at a shot. The other explosion requiring notice is that at Elemore colliery, which caused the death of 28 men: the origin of which is now being examined.

Attention has been recently directed to the question of a possible connection between issues of fire-damp in mines and movements of the earth's crust. From observations made in France it appears that there is a marked correlation between the issue of fire-damp, the intensity of micro-seismic motions, and the height of the barometer. The coincidences between increases of seismic activity and barometric depressions appear to prove that, if these depressions favour the issue of fire-damp, it is perhaps less by the effect of exhaustion upon the exposed coal than as a sequence of the compressions produced by them as local distortions of parts of the earth's crust which contains the seams or the reservoirs of gas.

A discovery has been made at Hutton Henry colliery, which will add another industry to the trade of the North of England. A bed of shale has been discovered similar to the famous oil shales of the Lothians of Scotland. The following is its analysis:—

Volatile matter	...17·96
Fixed carbon	...19·04
Ash	...63·00
	100·00

The Hutton Henry shale yields by distillation from 150 to 200 pounds of pure oil and 152 pounds of ammonia liquor per ton.

PRACTICAL NOTES FOR PRACTICAL MEN.

PREVENTING HOUSE PIPES FROM BURSTING BY FROST.

AT this time of the year, attention may be directed to an ingenious invention designed with the object of automatically emptying the water contained in the house main service pipes on the approach of frosty weather, and so preventing the house-water pipes from bursting and flooding the house. It consists of a special valve, screwed to the end of the house main service pipe in the cistern. A piece of wire is connected with it and attached to any convenient place. When frost is expected the spring must be unhooked, when the valve falls into its seat, and air being admitted through the small pipe which rises above the surface of the water, the pipes can be emptied by turning on the taps in the usual manner, and the water in the cistern is thus saved. To prevent the forgetfulness on the part of servants, &c., and to render this idea automatic electricity has been called in. A thermometer of special make is so arranged that when the temperature sinks below 32 degrees a current is shot through an electro magnet which releases a catch, causing the valve to fall into its seat, and, at the same time, opening a small cock at the lowest point of the house-water service pipes.

TERRA-COTTA LUMBER.

This is a most remarkable material brought into notice of late years, and eclipsing for its qualities any material hitherto known. Its name is certainly a misnomer to those ignorant of its appearance or origin. Its colour varies from a light buff to a fierce salmon. Its cellular formation is similar to that of a slice of bread, and its weight is about that of an equal mass of cinder. It stands a more intense heat than our fire-brick, and should, therefore, adapt itself to metallurgical and other purposes. It may be cut by chisels and by edge tools, can be pierced by nails, and manipulated and used as wood is in buildings. It may be used for lining doors of furnaces and for bridge walls in smelting furnaces and

boilers. Neither water nor fire exercise the least destructive influence on its composition, which is inexplicable when its formation is known. It is actually a waste substance—being formed of two waste substances at all events—the top layer of fire clay beds and sawdust. The former has hitherto been thrown away as useless, being unfit for common fire-bricks. Sawdust is of little commercial value, and the union of these two materials after exposure to heat results in the extraordinary substance now being described. Slabs or bricks of any shape may be moulded from it, and it is capable of being sawn or repaired exactly as is wood. In a word, asbestos has quickly found for some of its uses a formidable rival.

THE CARE OF SHAFTING.

There is no doubt but that there is less care bestowed on the banging of shafting than upon any other means used in applying power to manufacturing purposes. If the steam-engine or the water-wheel is in good working order, and performing its work properly, and the machines driven by them are also in good order, there is seldom a thought bestowed upon the media between the actuating power and its ultimate development, except the necessary attention which must be paid to the belting and oiling of the machinery. Often when the result of the power is not satisfactory, it is not the driving power which is at fault, but the result may be found in the shafting or other intermediate transferers of power. Generally, in such a case, the belts are examined and their conditions assumed for the imperfect transmission of the power from the prime-mover. The condition of the belts is a very important point in all manufacturing, but more particularly in mills, where a steadiness of motion is a desideratum, and attention to them will save many a pound in the course of a year; but there are other important elements which are not always taken into account, and the principal one is the condition of the shafting. A line of shafting running perfectly true, without jumping, or jerking, turning smoothly and noiselessly is a delight to the mechanical eye and the first thing always examined by a thorough millwright when he enters a mill is the shafting.

ON BUILDING MATERIAL.

An extensive trade in second building materials has been carried on uninterruptedly for the last 50 years, and is largely supported by joiners and builders.

The stone and brick work of an old building may be used in the construction of a new one, the lime-whitened bricks making the inner sides of the outer walls, and the partitions and the stone going into the foundations But it is not generally known that the inside woodwork is used up again, frequently without radical alteration. Many builders prefer this old timber because it is thoroughly seasoned. The richer woods which are admired for their colour, acquire mellower tones by age, and become more valuable as the years pass. Furniture of mahogany and rosewood that has outlived several generations is much handsomer than that made from new wood. But it has added value as mere material. An article made from old wood will retain its integrity in all its joints; its shrinking days are over. For the same reason the timbering wainscoting and flooring of old buildings have an added value, although the selling price is less than that of new material.

TERRA-COTTA AND BRICK.

The difference between terra-cotta and brick is one of degree rather than of quality. The original material is clay, which is chemically a hydrated silicate of alumina, with less than one-half of alumina or only 44 per cent. against 50 per cent. of silica and 10 per cent. of water. But the clay that is formed into terra-cotta is the same clay as to constituents, only that the constituents are of different characteristics. The silica in the ordinary brick clay is in grains, appreciable to the eye or the touch; while the clay suitable for terra-cotta is a mass in which the silicate cannot be distinguished from the aluminum. There is also a less proportion of silicate in the clays which are adapted for terra-cctta work in the finer qualities of pottery but the quality of the union is similar, only it must be noticed that while a high heat will vitrify the ordinary plastic clay it will merely consolidate that which holds a less amount of silica and in a finer condition. And it is not necessary that terra-cotta (burned earth) should be of a red hue to entitle it to its name, for pure terra-cotta can be of a cream colour, the adventitious colour of the red product being due merely to the presence of oxide of iron.

HALF-YEARLY ENGINEERING TRADES' REPORT.

LONDON: *January 1st, 1887.*

THE year just closed has been one of the worst ever experienced in the Engineering Trades, but in several branches a slight improvement has set in which bids fair to continue, and the prospects for the coming spring are brighter than they have been for the last two years. Since the date of our July Report there have been large investments of capital in undertakings which give employment to Engineers, and an increasing expenditure among manufacturers may be looked for. The revival of railway enterprise in the United States has given great impetus to the iron and steel trades of that country, and though free exchange with Great Britain is restricted by their fiscal system, the intimate connection between the two countries has always led to a corresponding improvement here.

COAL—Has been cheaper than ever during the last year, and in South Wales as in the North of England the reduced output at the collieries has told severely on the owners whose charges for royalties and maintenance cannot be reduced in proportion. With natural advantages greater than those of any other European country, the system of mining royalties is, in Great Britain, more onerous on those who have the risk of working the minerals than anywhere else, and some change by which the landowner shall receive a percentage of price or profit instead of the present preferential charge will probably have to be adopted if the pre-eminence of this country is to be maintained.

IRON.—The continued fall in the prices of pig-iron during the first half of 1886 was arrested by the natural remedy of a reduction in the output, and prices advanced in consequence. The prices of rolled iron have fluctuated during the last six months, and are now slightly higher than in the summer. They would be still higher but for the competition of steel, not only in shipbuilding, but in boilers, bridges, and other structures. At many of the leading rolling mills Siemen's and other steel-making plant has been established to meet the altered demand, and at some of the works favourably situated for suitable ore and fuel, the puddling furnaces and other appliances for making wrought iron are likely to be abandoned altogether.

STEEL—Which in the spring and summer of 1886 fell even more rapidly than iron, has during the last few months, recovered from 5*s.* to 10*s.* per ton. Owing to the collapse of the English and Continental rail makers' combination, prices of heavy steel rails fell as low as £3 12*s.* 6*d.* per ton, but the price now is from £4 to £4 5*s.* Although this recovery is assisted by the considerable manufacture of ship and bridge steel, the immediate cause has been the revival of the American demand. The total output capacity of the rail mills in that country is about two millions of tons per annum, and the contracts already made, and in view, absorb most of this quantity for 1887. The present duty of $17 per ton barely excludes English rails, and it is likely that the few orders already placed on this side will be increased. But a large export of steel blooms for rails and plates, and billets, principally for wire, is now taking place, for the duty on these being less than on the rails, plates or wire, into which they are ultimately made, there is the apparent anomaly and curious effect of the protective system, that American buyers can offer as much for these unfinished forms of steel as for finished rails. An exceptionally large contract for 50,000 tons of rails for Victoria has just been secured by the German firm of Krupp. In that protectionist colony it is desired to ignore the British manufacturer, and, when the goods cannot be made in the colony, to place all orders through local merchants. To encourage this, the seller is not only called upon to deliver there, but to submit the rails on arrival, instead of at the place of manufacture, to all the tests of quality by which acceptance or rejection is determined. Partly owing to these causes which disinclined though they did not entirely hinder English competition, and partly to the low freight obtainable from Continental ports, the order was lost to this country. The price obtained was equal to about £4 2*s.* 6*d.* per ton, free on board, and £4 17*s.* 6*d.* delivered in Melbourne. The tendency in England for bridge work is still towards milder steel, a breaking strain ranging between 27 and 31 tons per square inch being specified. It is more and more evident that the quality and trustworthiness of finished steel depends upon the amount of work upon it, that is, on the relation which the thickness of the finished plate or bar bears to that of the orginal ingot.

The following list shows the fluctuation and fall in values during the last five years:—

	Per Ton.						
	January 1882.	January 1883.	January 1884.	January 1885.	Jauuary 1886.	January 1886.	January 1887.
	£ s. d.	£ s. d	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Steam Coal, f.o b. at Cardiff ..	0 10 9	0 11 0	0 12 0	0 10 6	0 9 6	0 8 9	0 8 6
West Hartley Coal, f.o.b. at Newcastle	0 9 0	0 9 0	0 9 6	0 9 0	0 8 6	0 8 3	0 8 0
Pig Iron at Glasgow, No. 3 ..	[illegible] 11 [illegible]	2 9 0	2 3 6	2 2 6	2 1 0	1 19 0	2 4 6
Pig Iron at Middlesborough, No. 3	[illegible] [illegible] 0	2 2 6	1 16 6	1 15 6	1 11 6	1 10 0	1 14 0
Iron Ship Plates at Middlesborough	7 2 [illegible]	6 10 0	5 12 6	4 17 6	4 12 6	4 7 6	4 12 6
Iron Bridge Plates in South Yorkshire	7 15 0	8 0 0	7 5 0	6 10 0	5 17 6	5 5 0	5 7 6
Steel Ship and Bridge Plates ..	10 10 [illegible]	10 0 0	8 10 0	7 0 0	6 17 6	6 5 0	6 5 0
Iron Rails, f.o.b.	5 10 0	5 0 0	5 0 0	....	....	....	....
Steel Rails, f.o.b.	6 10 0	5 5 0	4 10 0	5 0 0	5 0 0	4 0 0	4 5 0

SCRAP IRON AND STEEL.—This trade altered considerably during the autumn, the Italian demand having fallen away, while that from the United States so strongly revived as to cause a great rise in values. The present price of old double-head rails delivered at New York is 73*s.* 6*d.* as against 52*s.* 6*d.* last July, old flanged rails shipped chiefly from Continental ports being now 71*s.* Scrap iron is also in demand, and the nominal price delivered in New York 60*s.* and 63*s.* for old spring steel, but there are few shipments owing to the dislike of shipowners to this kind of freight. The home demand is dull.

Mechanical Engineers are, as a rule, busier than they have been for the last two years, but this trade is so divided into special branches that no general statement is possible. Events seldom exactly repeat, and new developments are necessary to meet the altered trade of the country; mining appliances, electric light equipments, naval armaments, and harbour improvements being directions in which progress is apparent. Ironfounders have had to meet the lowest prices ever encountered and such cheap goods, as pipes and railway chairs follow closely the rates current for pig iron. But for miscellaneous castings improvement is dependent on the general engineering trades and founders will at once benefit by any amelioration in this direction.

Iron and Steel Shipbuilding.—This trade, which is almost entirely limited to Scotland and the North of England, has not only shared in the general depression of the two last years, but has felt it more keenly, because of the vast extension of manufacturing power in 1882-83. On the Clyde alone the annual tonnage launched, which had grown from 240,000 tons in 1880 to 420,000 in 1883, fell off to 194,000 tons in 1885, and has only been 172,000 tons in 1886. The statistics for the Tyne and the Wear, though on a smaller scale, show a similar reduction, but there are signs that a recovery is commencing, which is likely to grow. The great reduction in the merchandize carried has been one more of value than of volume, and it is the latter, of course, which determines the number of vessels employed. Foreign competition has not the same effect in this as in other branches of manufacture, for countries which see fit to encourage home industries by protective tariffs cannot carry out this system in the international rivalry on the sea, which is open to all. France has not benefited by her subsidized shipyards; Russia, which actually prohibited the ordering of steamers abroad, is still obliged to come here; Germany in establishing lines of steamers, has most of them built on the Clyde; and the Colonies, in their tendency towards Protection in other matters, must leave the shipping trade to the Mother country. The advantages which steel affords as a substitute for iron are now fully recognized, and the proportion of steel to iron vessels, which was only 18 per cent. in 1880 and 30 per cent. in 1883, has, in the year just closed, been 68 per cent. Triple expansion engines, rendered possible and profitable by the use of high-pressure steam in steel boilers, are now a necessity, for steamers propelled by less economical engines cannot compete with those having the greater economy in coal and stowage space.

Iron and Steel Structures.—A very large tonnage of bridgework has been made during the past year, most of it for export. Prices have risen slightly during the autumn, owing rather to the upward movement in the value of material than to any growing demand for the finished structures. The supersession of iron by steel advances slowly but steadily, the advantages of using it for small as well as large spans being obvious if the gain in strength and permanency are set against the extra cost. Taking £10 to £14 per ton as the present prices of iron bridges, according to design and quantity, an addition of 20*s.* to 30*s.* per ton will represent the extra cost of steel. The export of bridges to India has been maintained during the year, and the extension of railways there and in Burmah may be expected to continue it. There is a considerable export now going on to South America and Japan. In the Colonies, English and American bridge-builders come into competition, but there is less difference in style than formerly. In the United States the increased weight and frequency of railway traffic is telling severely on the earlier bridges, and engineers there are at last realizing that solidity and permanency against the impact of heavy trains require a weight and strength greater than their former method of dealing with theoretical strains provided. Iron roofing in additional station buildings are continually needed; there has been erected in London a large iron and steel building, about 300 feet wide and 100 feet high, with pivoted columns and other novel features of design; tenders have just been sent in for an unprecedented iron tank structure in Buenos Ayres, weighing 14,000 tons, to hold 80,000 tons of water, and manufacturers here get a fair share of orders from other parts of South America where building materials are scarce, and iron structures, many of them ornamental, are regularly imported from Europe.

Locomotives and Rolling Stock.—There are about a dozen leading firms engaged in this trade, none of whom can be earning much profit, most of them indeed hardly paying the expenses of working and maintenance. There are no prospects of an extended demand at home, for there is little extension of railways, and the existing Companies, while curtailing expenditure, are making more and more of their own engines. There has been a falling off in orders for the Indian State Railways, and although there has been considerable export to South America and other countries the quantity has borne a small proportion to the producing capacity available. Tramway engines occupy more attention than hitherto. The Railway Carriage and Wagon Factories are almost all in a worse condition than they have been for years. These factories were established mainly to supply the home railways with rolling stock, but the leading Companies have, one after another, established, with very questionable advantage, large works of their own. The private manufacturers are therefore more than ever dependent on foreign orders, which at present are quite insufficient to give full employment, and the competition of the manufacturers to obtain orders has brought down prices to a point which leaves no profit.

Agricultural Engineers.—Have experienced no change for the better during the past year, and the depression of the landed interest tells severely on all who make the machinery of farming. At home there seems no hope of improvement in the trades dependent on the land until more capital is invested in its cultivation and of this there is yet no sign. Abroad affairs are nearly as bad. The trade with Austria and Russia, countries which generally buy largely from England, at present promises very little and political disquietude hinders new developments. In the Colonies want of money has restricted imports, but some improvement is already apparent.

Public Works.—At home are at present few and inconsiderable. The number of Private Bills for railways and tramways deposited for the coming Session of Parliament is less than last year, as also is the number of provisional orders for minor works, and the two last Sessions showed each a similar falling off from the previous years. While however new railway projects are few and of moderate extent, increased facilities for transport are so necessary to the trade of the country that continual widenings and station extensions are called for; improvements and additions to harbours and docks are equally essential, and there is likely to be a considerable revival and development of canal and river navigation. Sanitation and electric lighting are taking a leading place as branches of engineering, to which home enterprise and capital may be directed. It is however on public works abroad that engineers, contractors and manufacturers have now to depend, and notwithstanding the present depression in the trades and professions depending on such works, the field for them is wide and varied. The concession by Spain to Great Britain of the most favoured nation privileges which have been withheld of late years, has already given impetus to the trade with that country, and Belgium, France and Germany have no longer pre-eminence there.

International competition depends more than ever on cheap transport. A revision of railway rates to the ports, a simplifying of dock dues, and the utilization of canals are immediate remedies which would help British trades, while ocean freights as low as those from Antwerp and Germany, which at present favour Continental manufacturers, are necessary if the export of engineering material is to be maintained and extended.

Matheson & Grant.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, February 5, 1887.

Lieutenant H. C. I. Birdwood, R.E., temporary Assistant Engineer, 2nd grade, State Railways, is transferred to the Punjab.

Railways.

Mr. E. F. Gordon, Assistant Engineer, 1st grade, is granted by Her Majesty's Secretary of State for India an extension of seven months' furlough in continuation of the furlough previously granted to him.

Mr. F. W. Roberts, Assistant Engineer, 2nd grade, is, in the interests of the public service, transferred from the Sind-Pishin State Railway to the Tounghoo-Mandalay Extension of the Burmah State Railway.

Mr. A. S. Gerrard, Executive Engineer, 2nd grade, is, on return from furlough, posted to the Tounghoo-Mandalay Extension of the Burmah State Railway.

N.-W. P. and Oudh, February 5, 1887.

Buildings and Roads Branch.

Captain E. Blunt, R.E., whose services have been placed at the disposal of this Government by the Government of India, Military Department, is appointed 2nd Assistant Principal in the Thomason Civil Engineering College, Roorkee, with effect from the 16th January 1886, the date on which he took up the duties of the appointment.

Bombay, February 3, 1887.

Rao Saheb Gopal Vishwambhar Gayatonde, L.C.E., is appointed to act as Executive Engineer, Kanara, during Captain Lister's absence on privilege leave.

Mr. F. D. Campbell, Executive Engineer, 1st grade, is allowed six months' special leave from the date he may avail himself of it in March 1887.

Mr. T. Summers, Assoc. M. Inst. C. E., is appointed to officiate as Executive Engineer, Khandesh, during the absence of Mr. Campbell on special leave.

Burma, January 29, 1887.

Mr. E. C. Elliot, Executive Engineer, 4th grade, temporary rank, reported his arrival at Rangoon on the forenoon of the 7th January 1887.

Mr. Elliot's services are placed at the disposal of the Engineer-in-Chief, Burmah State Railway.

Mr. J. Wallace, Executive Engineer, 4th grade, temporary rank is transferred from the Bassein division for employment in Upper Burmah under the orders of the Superintendent of Works.

Mr. C. L. Gilbert, Executive Engineer, 4th grade, sub. *pro. tem.*, reported his arrival at Rangoon on the forenoon of this date and is posted to the charge of the Bassein division.

Captain M. Laugharne, R.E., Executive Engineer, 2nd grade, sub. *pro. tem.*, made over, and Mr. W. Algie, Executive Engineer, 3rd grade, sub. *pro tem.*, received, charge of the Pegu division on the afternoon of the 21st January 1887.

Bengal, February 9, 1887.

Establishment—General.

Mr. W. A. E. Hanby, Assistant Engineer, is granted leave on medical certificate for ten months, under section 128 of the Civil Leave Code.

Mr. E. J. Martin, Superintending Engineer, class I. has been granted by Her Majesty's Secretary of State a further extension of furlough for six months on medical certificate.

Establishment—Railway.

Mr. C. Von Ahn, Executive Engineer, 3rd grade, is, on return from privilege leave, posted to the Assam-Behar State Railway.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

3rd February 1887.

141 of 1886.—Alexander Hill Rennie, Indigo Planter, Belsund Factory, Tirhoot. —*For a method of transferring volatile liquids such as liquor ammonia from closed vessels to other liquids or other vessels without exposure to the atmosphere, thus saving loss from evaporation or volatilisation and risk to persons employed in handling it.*

218 of 1886.—James Richard Bell, Member of the Institution of Civil Engineers, residing at, and Executive Engineer, of, the Sutlej Bridge Works, near Ferozepre, in the Punjab. —*For improved fittings for grab dredgers.*

9 of 1887.—John George Farthing, Mechanical Engineer of Rotherhithe, Surrey, London, at present Resident Engineer, Bengal Ice Manufacturing Company, Limited, Calcutta. —*For cooling water for ice-making machinery or condensing water of steam engines or for cooling any kind of liquid.*

SELECTED ABSTRACTS OF RECENT BRITISH SPECIFICATIONS.

Improvements in the Permanent Way of "Railways".—No. 15,347. *J. M. Wrench M.I.C.E.* Lahore, India. Application filed, 14th December 1885. Patent sealed, 24th December 1886.

This invention consists of an improved form of chair, sleeper, and tie-bar, the latter being so formed as to serve the double purpose of preserving the gauge of the line and of securing the rails on the chairs.

Each chair is carried by a separate sleeper formed of a flat, oval or rectangular plate with a downwardly projecting flange round the edge to retain the ballast.

The chair consists of a saddle piece either cast in one with the plate, or in the case of a wrought iron or steel sleeper rivetted to the plate or bulged up from it. Suitably shaped jaws to retain the outer edge of the rail base are formed upon or rivetted to the top of the saddle. On the inner side the rail is held down by a jaw formed on or secured to the tie-bar which passes across from one rail to the other and preserves the gauge. The tie-bar at its ends is made to pass through the saddle pieces of a pair of sleepers and to extend beyond the outer side of the rails. A split metallic key passed through a slot near each end of the tie-bar draws the jaws on the saddles towards the jaws on the tie bar and so causes the base of the rail to be securely gripped between them. The keys pass through slots in the chairs either inside or outside the rails. The tie-bars may be made with two sets of jaws on opposite edges and of slightly different gauge, the jaws nearest together being used for straight pieces of line and the others for sharp curves where the gauge requires widening. The shape of the jaws is modified, to suit the rail employed, whether of double-headed, flat-footed or other section. In certain cases short bars may be employed which only hold the rail in position, separate bars being employed for ties.

Various modifications of the invention are shewn in the drawings and the specification contains 4 claims.

"Improvements in Telegraphing Apparatus used in connection with Engines". No. 15,324. *W. Chadburn, of Liverpool, England, Optician.* Application filed, 14th December 1885. Patent sealed, 24th December 1886.

The "Chadburn" ship's telegraph is now generally well-known, and the present invention is an ingenious arrangement for connecting an indicating dial on the ship's bridge with the reversing gear and throttle valve of the engines. An indicating dial in the engine-room may also be employed if desired. In the case of a marine engine, for example, fitted with a throttle valve and the ordinary eccentric and link reversing gear, a radical link, called an "alternator", is connected with the throttle valve through two bars connected to the ends of the link and to a disc, which disc is through a third rod connected with the throttle valve lever. The lever on the rocking-shaft which works the reversing gear is coupled by a rod with the centre of the "alternator."

In the slot of the "alternator," a pin works, carried on a lever so arranged in connection with the indicator that when the throttle valve is closed, the pin assumes a central position and the indicator stands at a neutral point on the dial. whatever may be the position of the reversing gear, but when the throttle valve is wholly or partly open, the pin will stand at or towards one or the other end of the link, according to the position of the reversing links of the engine, and the extent to which such links may be set or thrown over in one direction or the other. The pin will thus be depressed, or raised as the case may be, and this movement is transmitted by any suitable connections to the indicator dial.

There are 3 claims to the specification and four views of the apparatus shewn in the drawings.

M. DE LESSEPS, Sir J. Stokes, and Mr. Aynsley, who are at Cairo on behalf of the Suez Canal Company, have come to terms with the Egyptian Government. The Company will pay £80,000 for a certain quantity of land at Suez, Ismailia, and Port Said, and along the Canal, for the purpose of widening it, which will be effected by degrees.

Extracts.

GOVERNMENT SERVANTS AND THE PUBLIC PRESS.

THERE seems to be a wide impression that Government Officers are not at all at liberty to contribute to the public Press. The following order of the Government of India on the subject, which was issued on 18th July 1875, and is still in force, ought to convince the official classs that, under certain conditions they can contribute to the public prints. The order runs thus :—"Officers in the service of Government are not prohibited from contributing to the public Press; but their position makes it incumbent upon them to confine themselves within the limits of temperate and reasonable discussion, and they are prohibited from making public, without the previous sanction of Government any documents, papers or informtion of which they may become possessed in their offical capacity. These rules have hitherto been in most cases honourably observed. In case of a departure from them, or if the Government should consider the connection of any officer with the Press to be contrary to the public interest, his liberty to contribute will be withdrawn." We know there are many Government officers who are quite willing to contribute to the newspapers, but are dissuaded from doing so, because they labour under the mistaken notion that they have not the least right to keep any connection with the Press. We trust a perusal of the Supreme Government's Order on the subject quoted above, will convince them of their error, and encourage them to write on and discuss such public matters of which they may happen to possess special knowledge.

THE WISDOM OF TECHNICAL EDUCATION.

"EDUCATED labour," says the Vice-Chancellor of the Calcutta University, "is cheap in India." Had he said "semi-educated idleness," he would have been nearer the mark. And because this labour is so cheap: because it can find no outlet in Government or private employ; it has been proposed—and Bombay has already voted money to this end—to loosen a further flood of "technical education" upon the land. As we have before said, the bulk of the native educated community approve of the scheme because they do not quite understand what it means; but believe it is something that will bring them posts and pay. Already they demand that Government should start factories—presumably for making wares by native agency and buying those wares afterwards. "Does poultry keeping pay?" asked the town of the country cousin. "M'Yes. It's supposed to. I buy the fowls you know, and the cost of food and coops come from my pocket. Children sell me the eggs and they eat 'em." In somewhat the same pleasant manner should the scheme now in course of hatchment be worked before it will thoroughly satisfy the apirations of those who think that they are concerned in it. But paternal Government cannot be quite so paternal as this. There must come some help, some response from the pepole whom it proposes to benefit.

BOMBAY JOINT STOCK CONCERNS.—1885.

MOST of the Press Companies have done remarkably well, and have paid what may be called handsome dividends. Amongst Land Companies, the Colaba Land and Mill Company and the Port Canning Land Company have done fairly well. The Company last named paid Rs. 19 per share dividend for the past year. The year before last the directors paid Rs. 14 per share. Last year they paid Rs. 16 per share, and this year they have been enabled to pay Rs. 19 per share. This shows that the remunerative powers of the company are steadily increasing, and that it has a prospective value. In Miscellaneous Companies, Bombay Burmah Trading shares have during the year given way about Rs. 1,000. This, of course, is on account of the uncertainties about the future of the company, consequent on the present unsettled state of affairs in Burmah. The last dividend declared by the company is only Rs 135 per share, which comes to be a little over 5 per cent. on the present price. The shares close weak at Rs. 2,600. Other companies, such as Treacher and Company, Thacker and Company, Kemp and Company, Badham-Pili and Company, the Bombay Ice Company, the Cooper Madon and Campany, Phillips and Company, and a few others have done well and have paid good returns for the past year. The first three, namely, Treacher and Company, Thacker and Company, and Kemp and Company, may be said to have done remarkably well. Amongst the flour mills, Bombay Flour Mills and Western India Flour Mills have shown very satisfactory results of their working during the past year. The same cannot be said of Bapty Brothers & Co. The report lately issued by the Company is considered very unsatisfactory. Last year the company's profits amounted to over a lakh. This year a loss of about Rs. 5,000 is the result. Amongst the New Companies floated during the year may be reckoned the New Flour Mill started by Messrs. Lang, Moir and Company, the Clydesdale Dyeing and Manufacturing Company, and Geyer and Company, Limited.

IRRIGATION WORKS IN THE PUNJAB 1885-86.

THE area irrigated in the Punjab during the year 1885-86 was 1,787,-167 acres, against 1,614,288 acres in the previous year. The increase was due to an extension of 128,595 acres from the Bari Doab Canal, and 116,735 acres by the Sirhind Canal, while the Swat River Canal, which was only opened in February 1885, irrigated 44,902 acres. On the other hand, there was decrease of 55,586 acres in the irrigation from the Western Jumna Canal, and of 60,527 acres from the inundation Canals. The total capital invested by the Government was Rs. 5,-52,99,891, to which must be added Rs. 1,18,67,230 contributed by the Native States to the Sirhind Canal. Of these totals Rs. 32,63,317 was spent on the Swat River Canal, which is classed as famine relief and insurance work. The net revenue on the capital invested was by assessment, a profit of Re. 0·12, but according to the collections there was an actual loss of Rs. 0·82 per cent. The gross revenue collected was Rs. 25,61,018, the assessment being Rs. 30,80,956. The working expenses amounted to Rs. 13,22,049, and the charge for interest was Rs. 19,35,652, thus showing a loss of Rs. 6,96,683 on the invested capital.

Notices.

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CONTENTS.

Answers to Correspondents.

SEVERAL Contributions are unavoidably held over, but we have increased our space, as a temporary measure, to dispose of arrears.

INDIAN ENGINEERING.

SATURDAY, FEBRUARY 19, 1887.

THE PUBLIC SERVICE COMMISSION.

I.

IT is recorded of a certain eminent man that he took all knowledge for his province. Our aim is more restricted. The field of human enterprise may be divided into three spaces, Science, Art, and—the et ceteras. In the last we place such questions as—how to make a fortune on the Stock Exchange—how to introduce Home Rule into Dublin (or resist its introduction)—and how to persuade the German Reichsrath to increase (or it may be abstain from increasing) the armed strength of the Fatherland. The latter two questions may be of quite first rate national importance, and to many of us that other financial question might appear of first rate personal importance. If in these columns we omit all consideration of such topics ; it is not because they are insufficiently large, but because they are not sufficiently scientific. As soon as any question is organised into a science we should use our best efforts to understand it.

Similarly, as far as, and as long as, questions of Sculpture, Music, Poetry or Literature generally are questions of pure Art, we leave them unconsidered, though we hope not unappreciated. Art, however, if true Art, is only unconscious science. In proportion as the principles of Art are formulated and generalised—that is, in proportion as Art acquires consciousness—it developes into real Science. Thus the boundaries of Science are ever widening, and neither monarch nor artist can stand on the shore and say to its advancing waves "thus far shalt thou come but no farther." All political questions are gradually being brought within the domain of Science. Wherefore it comes to pass that even the questions raised by the Public Service Commission can be treated to some extent scientifically.

The geometer asks himself how his friend the farmer should lay out a given length of palisading in order that it may enclose the greatest possible area of a field where cattle are put to graze. The bee—another geometer—has asked itself in what shape of a pyramid it should finish off its prismatic hexagonal cells that these pyramids may dovetail into each other and be most economical of wax. The Engineer asks himself how he should build a bridge or a breakwater so that as much as possible of the material used may intervene actively—that is, by virtue of its tensile or crushing strength, and as little as possible passively—that is, by its dead weight only. All these questions the mathematician sums up as questions of *maxima* and *minima.*

Well, the Public Service Commission are now initiating the discussion of some questions of *maxima* and *minima.* How shall a country discover administrative talent among its citizens? How shall it utilise this talent most effectively ? How shall we persuade the greatest number of intelligent people to take a reasonable and sympathetic view of the difficulties of wisely governing ? How shall we best harmonise those conservative instincts which are needed to preserve continuity in administration with

those progressive instincts which call upon the governing power to adapt itself to the ever growing necessities of a country? A primitive civilisation is like a worm. If an accidental spade thrust removes a few inches of its body it "carries on business as usual" with the inches that still remain. A developed civilisation becomes more sensitive. Its energies are directed by more subtle agencies and its life is altogether more complex.

Mathematics are usually called the exact sciences by those who have not studied them. To those who know that mathematics might more properly be called the sciences of careful approximation, it becomes more evident that a scientific training may be of use as a preparation for political problems. The builder of a large iron bridge hardly ever uses a formula which is absolutely exact. His most valuable formulæ are chiefly approximative. But they are used in a manner which is exactly scientific; because he is always able to define the amount of error they involve.

There is such a thing as a science of government—there are scientific principles underlying a wise administration. Public Service Commissions must from time to time exercise themselves over problems of *maxima* and *minima* and over questions of just approximation. The object to be aimed at is not the less clearly seen, because it is recognised that the arrows they shoot will never quite hit the mark. And as we watch some Public Service Commission at work we, in common with all our contemporaries whose *métier* is Technical Industry, may from time to time see principles enunciated which are truly scientific.

THE BATTLE OF THE GAUGES.

II.

THE Rajputana-Malwa line between Ajmere and Ahmedabad, where it meets the Bombay and Baroda broad gauge line, was opened section by section as completed, but throughout on the 30th January 1881, by Sir James Fergusson, who during the previous year had become Governor of Bombay, and under whose administration the whole of the Rajputana system was placed from the date of the through opening. In his speech at the opening ceremony, Sir James Fergusson, who had had much experience as a Railway Director at home, while expressing satisfaction with the manner in which the railway had been constructed, spoke as follows:—

"While I would not say one word to damp enthusiasm, I cannot, as a railway man, be thought to express satisfaction at the construction of the new railway on the narrow gauge (loud and prolonged applause). I believe that system to be founded on a great mistake. It is not economical in any sense; it will be found to be extremely expensive in working (hear, hear); and I do not think it is destined to endure long."

Who was nearest right, Mr. Rendel, or Sir James Fergusson?

To meet the difficulty that was from the first foreseen, and that has now become pressing, General Trevor, in the speech we referred to at the outset, said that the lessor Company have offered, under their guarantee, to extend their Godhra branch on the broad gauge to Rutlam, on the Ajmere-Indore section of the Rajputana-Malwa Railway, which, he said, would cost less than the doubling of the Rajputana-Malwa Railway between Ajmere and Ahmedabad, and that this proposal was under the consideration of the Government in India. But he also said that, looking to the prospect of traffic from the vast tract in the east of the Punjab which lies between the Rewari and Ferozepore and the North-Western Railways, and to the wants of the Simla region, his Company had, but a few days before he spoke, proposed to the Secretary of State that they should be permitted to organize an affiliated company (to be managed by them) to make a railway from some point on the Rajputana line near Ajmere direct to Umballa and Kalka, which would answer instead of doubling the Rajputana line between Ajmere and Bandikui junction. This proposal will be hotly opposed by all the interests connected with the Western Punjab and Kurrachee, for whose benefit it has been variously proposed to construct a line from either Patiala *viâ* Fazilka to Bahawalpur, or from Ludhiana *viâ* Ferozepore and Fazilka to Bahawalpur, to meet the line from Mooltan to Kurrachee, and no hasty decision will likely be come to on this point of the Bombay Company's proposals.

The formation of a party under Mr. Parker to survey the proposed extension of the Godhra branch to Rutlam, and the deputation of Colonel Pemberton to go over the Rajputana line and give instructions for the preparation of alternative estimates of the cost of doubling the railway and of converting it into a broad gauge line, show that the Government of India at least is alive to the necessity of speedily doing something to avert the threatened block of traffic.

PROVINCIAL WORKS—PUNJAB.

WHILST the Government of India is doing its best to impress on the various Provincial Administrations the necessity of retrenchment in every direction, it may as far as the Punjab is concerned be instructive to note that the Secretary to Government in that Province in the D. P. W. has before him sundry demands from the different districts entailing, if accepted, an expenditure aggregating over seventy-two lakhs of rupees, and this, be it borne in mind, is solely for *new* buildings—Police, Land Revenue, Civil and Excise, all of which are stated to be *urgently* wanted. It goes without saying that the demands for works which are not urgent *and can stand over* are not included in this list.

In the face of the annually increasing demands of the Civil Departments on the D. P. W., the fact is rather significant that the cost of maintaining the great lines of communication cannot be reduced, but exhibits a tendency to expand. From statistics recently prepared, it was shown that the average all round cost of maintenance for the Grand Trunk Road and its various metalled feeders, amounted to something like Rs. 800 per mile per annum. This, of course, includes renewal of metal, earthwork and petty establishment; and to still further aggravate the situation the *kankar* quarries in many parts of the Punjab are said to show signs of exhaustion.

The demand for *kankar*, oolitic limestone as it is technically termed, has for years been enormous; the best quarries have been worked until the stocks now available are within a measureable distance of becoming *played out*. This danger has been recognised, and we have good grounds for stating that ere long Engineers will have to look to the beds of the great rivers, the Jamna, Satlaj, Bias and Ravi, where they debouch from the hills, as the sources of supply for metal, boulder stone, procurable in inexhaustible quantities.

Boulder stone will in most localities where *kankar* is now used cost at first charge more than *kankar*, but owing to greater durability will in the long run probably be found to be just as cheap. We learn that the Superintending Engineer, 2nd Circle of Provincial Works, has made arrangements for bringing boulder stone down from the Jamna by canal boats in order to meet the requirements of the Grand Trunk Road between Amballa and Delhi.

The life of a coat of ordinary *kankar* cannot be taken at more than six years, though some *kankar* got from the old quarries has been known to stand *ten* years on the road, and even then show little or no symptoms of failure. With good boulder, quartz or limestone, if well consolidated, a life of ten to twelve years might safely be counted on, though the almost prohibitive rates at which metal is now procurable in most parts of the Province renders it extremely unlikely that the Punjab Government will consent to any further extension of its system of metalled roads—on which the material prosperity and development of the country depends.

Notes and Comments.

ALLAHABAD WATER-SUPPLY.—The water works scheme was revived again in connection with the Jubilee, and was so seriously under discussion that the Municipal Board is said to now have water on the brain. The problem, however, to be solved is by no means an easy one, *viz.*, to meet the requirements of a population of 150,000 over an area of seven square miles with a connected drainage scheme and—no funds available!

THE NEW INDO-BRITISH SCHOOLS BUILDINGS, BOMBAY.—The new buildings recently opened for the Indo-British Institution, situated on the Esplanade, opposite the G. I. P. Railway terminus, to the south of the School of Art, were designed and built by Khan Bahadoor M. C. Murzban, A.M.I.C.E., Executive Engineer at the Presidency, and are in the Domestic Gothic style. The total cost of the buildings is about Rs. 1,12,728. Government granted the site, valued at Rs. 1,20,000, free of cost, in addition to an allotment of Rs. 56,000 from provincial funds.

CEYLON RAILWAYS EXTENSION.—The Secretary of State firmly refuses to sanction the proposed railway extension to Haputale. Not only is sanction to extension on a broad gauge refused, but the construction of a 2 feet Darjeeling line refused, because it is deemed inadequate for the work it will have to perform. Furthermore, permission is given to any private company to construct a line to Haputale or Badulla whenever they like. Such is the tenor of the despatch—"neither the costly broad gauge nor the trumpery Darjeeling line," as both are unsuited to the needs of the Island.

THE TRUSTEES OF THE MADRAS HARBOUR AND THEIR VAGARIES.—The Board consider that it is unnecessary to retain the services of Mr. Parkes further as Engineer-in-Chief; when they require special advice, they will be prepared to pay for it. As regards Mr. Thorowgood, the Board after recording their opinion that they entirely disagree with the Superintendent's views of his relations to them, and further charging that Officer with arrogating to himself the right to enter into a most important contract in direct opposition to their clearly expressed orders, they hesitate accepting the resignation of his position when tendered by the Superintendent!

PUNJAB P. W. D. CHANGES.—The following transfers have been made in the Punjab General Branch:—Mr. T. E. Ivens on being relieved of his duties in the P. W. Secretariat, to Peshawur Provincial Division (head-quarters at Abbottabad); Mr. B. G. Wallis, Executive Engineer, from Peshawur Provincial Division to Umballa Provincial Division; Mr. F. E. Rose from Umballa Provincial Division to Derajat Division; Mr. A. Grant, Executive Engineer, from Derajat Division to Murree and Kohala Road; Mr. F. C. Murray, Executive Engineer, from Murree Kohala Road to Jallandhar Division; Mr. S. F. Cox, Executive Engineer, from Jallandhar Division to Bannu Bridge Division, in place of Mr. B. Parkes proceeding on furlough.

JUBILEE HONOURS.—*K.C.I.E.*:—Bradford Leslie, M.I. C.E., Agent, E.I.R.; Albert James Leppoc Cappel, Director-General of Telegraphs in India; Alexander Meadows Rendel, M.A., M.I.C.E.; Dietrich Brandis, C.I.E., Ph. D., formerly Inspector-General of Forests in India; Major General Alexander Cunningham, C.S.I., C.I.E., Royal Engineers (Retired), lately Director-General of the Archæological Survey of India. *C.I.E.*:—Henry Montague Mathews, M.I.C.E., Manager and Engineer-in-Chief, Burma State Railway; Carl Ludolf Griesbach, F.G.S., Deputy Superintendent, Geological Survey; Colonel John Stewart, R.A., Superintendent of Harness and Saddlery Factory, Cawnpore.

THE MINERAL RESOURCES OF TONQUIN.—Foremost among the mining products of the new French dependency is coal, found in widespread deposits which have lately been prospected by experts with Annamite and Chinese labourers. The result of these researches under the guidance of experienced mineralogists from France, has put beyond doubt the existence of extensive coal-bearing seams lying parallel with the coast line. They have been thoroughly surveyed topographically and geologically. The area covered by these deposits is not inferior to that of the coal bearing districts in France. These experts have also conclusively established the existence of iron in "payable" quantities for industrial purposes.

THE DECCAN COLLEGE OF SCIENCE.—The total number of pupils on the rolls at the end of the year 1885-86 was 255, of whom 116 were in the Civil Engineering Department, 38 in the Agricultural Department, 11 in the Forest, and 90 in the Mechanical Department. Of the whole number, 137 were Brahmin, and 61 other Hindoos, 33 were Christians, 21 Parsees, 2 Jews, and there was 1 Mahomedan, 99 were sons of officials whether in the service of Government or Native States, 40 were sons of landholders and for the rest most classes of the general community were represented. In the University classes 13 passed for the degree of L. C. E., and 14 in the F.C. E. Examination, against 7 and 25 respectively in the previous year.

SURVEY OF THE RANEEGUNGE COAL FIELD.—It would appear that the proposed survey will not be of such an extensive character as at first contemplated. The Commissioner of the Burdwan Division thinks that the simplest and most effective method would be to lay down the outlines of the area worked, giving a separate colour to each of the large companies, and one colour to all the small ones. This would show the extent of the workings, the relative proportion and position of the area worked to that remaining unwrought, the boundary of the workings of a colliery and their proximity or otherwise to that owned by rival proprietors. To do more than this, we think with the said officer, it would be expensive and unnecessary.

COLOMBO *versus* The RAMISSERAM CANAL.—Many, qualified to judge, are of opinion that the Paumben project dooms Colombo as a port of call and coaling station for Homeward and Eastward bound vessels. So far as can be judged, considerable progress appears to have been made of late regarding the floating of a Company to carry out the *new* scheme. The Company is said to be actually floated with a capital of one million sterling, and the contract for the work actually drawn up, and given to Messrs. Glover and Co. The danger to Colombo is apparently very real, unless the Canal Company's rates are deterrent; but as this is improbable, the only remedy for Colombo would be to abolish all Harbour dues and charge the interest on the Harbour Works to the general revenue of the Colony.

SEERPORE JUTE MANUFACTURING COMPANY, "LIMITED."—The following remarks from the Report of the Directors for the past year are both instructive and interesting as regards the industry at large:—"The period under review was not marked by a corresponding advance in the prices of bags so as to cover the enhanced cost of production, caused by short time work, and to leave a fair profit. The Directors have, however, in the interest of the trade, joined in the renewal of the existing short time agreement proposed by the Jute Manufacturers' Association, increasing the time of working from 8 days to 9 days in two weeks, for a further period of one year certain from 15th February 1887, which it is hoped will place the market in a healthy position." The unsold stock of bags with almost all the Mills is, we are informed, practically *nil*—notwithstanding a long period of bad trade and great depression.

THE SUKKUR BRIDGE.—Excepting the great Forth Bridge, which is now being erected at Queen's Ferry, the Sukkur Bridge is by far the largest and boldest example of the cantilever principle; and its erection over the Indus—at a point where the river has great depth and swiftness—will be one of the most interesting of modern engineering achievements. The bridge is intended to span the Rohri Pass of the Indus at the town of Sukkur. The cantilevers are each 310 feet in length, and the centre span resting on them is to be a lattice girder of 200 feet. As there is but *one* span, anchorage has to be provided on each side. The bridge is for a single line of railway of 5 feet 6 inches gauge. The ironwork is in the hands of Messrs. Westwood, Baillie and Co., Poplar, who built the Chenab Bridge, the Empress Bridge, and the Attock Bridge for the Indian Government. The bridge was designed by Mr. A. M. Rendle, is being watched, on the part of the Indian Government, by Mr. R. E. Egerton of the P. W. D., and will be erected at Sukkur by Mr. F. E. Robertson of the P. W. D.

Current News.

PROFESSOR Theodore Cooke and Colonel Merewether have been elected Syndics in Engineering, Bombay University, for the ensuing year.

LIEUTENANT-COLONEL B. J. GOLDIE, R.E., M.W. Department, is transferred to the Sirhind and Lahore Command, with a view to his officiating as a Superintending Engineer.

THE Rawalpindi Waterworks, which are now all but ready, will be opened next month; His Honour the Lieutenant-Governor of the Punjab going to Rawalpindi to preside over the ceremony.

COLONEL HASTED, R.E., accompanied by Captain Taylor, the Master Attendant, Madras, and Mr. Massey of the Napier Foundry, visited Gopalpur to finally decide on the construction of the pier at that port.

THE Mysore Gold Mining Company crushed 594½ tons of ore last month, and obtained 1,181 ozs. of gold. The Nundydroog Company crushed 61 tons of ore in the last two months and obtained 50 ozs. of gold.

THE Railway from near Dibrugarh on the banks of the Brahamaputra River to near Sadiya with its branches, hitherto known as the Assam Railway, will, in future, be officially designated the "Dibru-Sadiya Railway."

THE Director-in-Chiefship of the Indo-European Telegraph Department, rendered vacant by the death of Colonel Sir J. Bateman Champain, will, we learn, be united with the office of Director-General of Indian Telegraphs.

KEROSINE again is simply pouring into India, which during the month of December, alone absorbed nearly 22,750,000 gallons. During the whole nine months, we imported 89 lakhs worth of kerosine, which, at this rate, will soon become a fitting subject for taxation.

MR DENHAM, the Chief Engineer of the East Indian Railway, with the Deputy Consulting Engineer of Guaranteed Railways, left Howrah on the 7th instant to inspect the line up to Delhi. This may account for Mr. Denham's non-attendance as a Juror at the Calcutta Sessions and for which he was fined Rs. 50.

THE Allahabad paper hears that the Amir of Cabul has obtained the services of Mr. Payne, of the firm of Walsh, Lovett and Co., to supervise his workshops in place of Mr. Kirchgesner, who is going on leave. Mr. Payne takes all risks, but the direct patronage of Abdur Rahman is a good guarantee of his safety.

AT Patna an Industrial School was proposed eleven years ago to commemorate the visit to the city of the Prince of Wales. Two lakhs of rupees were subscribed, but the project was not carried through, and the money was lent to the Municipality. It is now suggested that the money may be appropriately devoted to a Jubilee Technical Institute.

WE learn that orders have been received from the Board of Directors for a re-organisation of the administration of the Madras Railway, including—(1) the feasibility of an amalgamation of the office of Agent with that of Chief Engineer or some other head of department; (2) the reduction in the present staff of engineers, or in the scale of salary of the higher paid engineers.

COLONEL W. A. J. WALLACE, R.E. and Mr. A. C. Cregeen, C.E., have just been prospecting the country from Saugor, through Damoh to Kutni, a length of about 116 miles, over which it is proposed to construct a line and which the Indian Midland Company might be called on to make in terms of their contract. But the professional report is believed not to be favourable to the project.

THE Government of India have decided that officers of Royal Engineers who have elected, or who may hereafter elect, for continuous Indian service either in a civil or military appointment, will be eligible only for non-regulation passages by troopship when proceeding on and returning from furlough. It has been further decided that the officers referred to are eligible to join the Civil Engineers' Provident Fund.

THE Indian Midland Railway Company have decided to construct a line of about 48 miles from a point on the Great Indian Peninsular line to Saugor. The work will be commenced immediately. The point is at present known as Etawah, but that is the name of a too familiar station on the East Indian line to be lightly adopted. There is a proposal to call it "Victoria Junction," which is by no means a bad one.

MAJOR STONE, R.A., Superintendent, Small Arms Factory, Dum-Dum, and Mr. Beatts, Chief Mechanical Engineer of the Factory, proceed to England by the troopship leaving Bombay on the 19th March next, for the purpose of acquiring a knowledge of the manufacture of the solid drawn cartridge, the manufacture of prizes and other ordnance stores, and for the examination and passing of machinery ordered for the factory.

BOTH the Viceroy and the Lieutenant-Governor of Bengal will be present at the ceremony of opening the new bridge over the Hooghly on the 21st. The East India Railway Company have invited a goodly number of guests, who will leave Howrah at eight in the morning for Hooghly station and await the coming of the Viceroy from Barrackpore. By desire of the Viceroy, military guests will appear in undress uniform, and everything possible will be done to distinguish the occasion.

THE first cargo of Aden-made salt was recently despatched to Calcutta by the *Anjar Head*. The salt is made on scientific principles in pans constructed for the purpose at Sheik Othmam and

under a concession from Government. The business is worked by Italian capital, and now that some questions which prevented the work being pushed are settled, vigorous efforts are being made to bring the business to a head. It is expected that, when completed, 40,000 tons per annum can be made.

A CORRESPONDENT who contributes to a contemporary an account of the Ruby mines expedition says that Ruby mines are of four kinds, the most valuable being gullies formed by the action of water in the sides of the hills. Next to these come the shafts or tunnels sunk in the hill sides; and lastly wells. These last are sunk in the valley, and are of two kinds, the deep ones sunk to a depth of 15 or 20 feet, and the shallow ones only sunk to four feet, where the first ruby-bearing stratum is found. Rubies, or rather red stones of sorts, are offered for sale in large numbers, and at every conceivable price.

LAST Tuesday evening the members of the Public Works Department, officers of Royal Engineers and Civil Engineers of Bengal, dined at the Dalhousie Institute on the occasion of entertaining as their guest, Colonel W. S. Trevor, V.C., R.E., Secretary to the Government of India, Public Works Department, on the occasion of his returning to England. Over eighty officers of the Royal Engineers and gentlemen of the Profession were present. The health of the guest was proposed by his successor, General Hancock, and was cordially responded to by every one present, all uniting in wishing their eminent guest a safe and prosperous voyage home.

THE offices of the Eastern Extension Telegraph Company, located in the Post and Telegraph buildings, South Beach, Madras, are now being lit with electricity. The "installation" consists of 7 Edison Swan 10 candle power Incandescent lamps, and Holmes-Burke Patent Primary Battery, manufactured by the firm of Johnson and Phillips, London. The battery is capable of lighting 10 lamps, but up to the present only seven have been fitted up, and five used at a time, there being no need for more in the office. The cost of maintenance of the primary battery is high as compared with kerosine lighting, owing to the price of the chemicals in the local market; but the system has its advantages. The light is brilliant and steady, and there is little fear of a break-down which is unavoidable in the dynamo and engine system of lighting.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

THE PROMOTION OF INDIGENOUS ART.

SIR,—Very interesting scraps have appeared in the *Pioneer* lately, called "Archæological chips." If an appeal were made to the public in all the Presidencies of India, I am sure that enthusiasts would spring up and gladly supply you with information regarding old Indian architectural remains and native art of the present period.

In the *Pioneer* of the 28th instant "Gwali," who is evidently an enthusiast in this part of India—the N.-W. P. and Oudh—writes about the selection made by the Government of Messrs. Cole and Kipling, who are to be entrusted with the designing of the new buildings at Gwalior. In my opinion the designing members should have been a *triumvirate*. It is not too late yet to add to the list the well-known *connoisseur* of native art, Mr. Salmon Growse, C.S. One has only to visit Muttra to see that *native art* and *feeling* under Mr. Growse's fostering care does not exist only in name. I concur with "Gwali" in his assertion that Major Jacob's designs do not *wholly* express *native thought* and *feeling*. This fault, *if it can be called a fault*, is I maintain on the right side, for everything *purely native* is *unstable*, which nobody can deny. As the native character requires a great deal of *Western ideas and culture* instilled into it, to make it acceptable as something approaching to the genuine article; so do *all things* emanating from the native mind require more than a touch of *pure ideas* and *chaste feeling* to make them acceptable to those who are real judges of Asiatic architecture

R.

COMPARATIVE OUTTURN FROM SUGARCANE.

SIR,—In a copy of your valuable weekly ENGINEERING, I saw an account of an improved method of obtaining a larger outturn from the sugarcane. I think there must be some mistake in the quantity.

In some of my trials with cane grown in India, which is far inferior to cane grown in Louisiana, I have got from one ton of cane 170lbs. of sugar. This was an average on little more than two acres. We did not extract a third quality of sugar as we used the syrup for distilling, and if it had been worked there would have been a further outturn of about 10 to 15lbs.

The mills we were using were made in this country with the ordinary three iron rollers.

Should there be any mistake, I hope you will let me know, as I am much interested in sugar-growing and have tried a great many ways to obtain a larger outturn.

Trusting you will excuse the trouble given.

RENIGUNTA, *N. Arcot; Feb.* 5, 1887. N. J. B.

The information referred to was derived from Official (American) sources. Perhaps some of our readers might be able to throw further light on this subject.—ED., *I. E.*

POSITION OF RAILWAY STATION PLATFORMS.

SIR,—Travelling lately on the Bengal and North-Western Railway, I was surprised to see that the platforms of all the stations were situated on sidings and not on the main line. I had thought that, for railways on which there were no fast running and seldom stopping trains, this arrangement was an obsolete one. Where the platform is on a siding every stopping train must run over two sets of points and crossings and round two curves of sharp radius, so that every wheel gets several kicks at each station, and the flanges are ground against the rails on the curves, and these are certainly great disadvantages. Will any of your readers enlighten me as to what the counterbalancing advantages are?

"TRAVELLER."

Notes and Queries.

A. E. writes:—When a breakwater is made on the faulty principle of a vertical wall it might be strengthened, by a sort of strut. The lower ends of a number of these could be bolted into a sort of plank lying at the bottom. Then, when a sea wave gave a blow at one part of the wall, all the struts would help in resisting.

The struts and base plant might be made of iron thickly coated with paint, and these from time to time could be renewed if necessary. Another way would be to build masonry steps on the land side.

Work on the land side is easy, because the water is calm; but could not the outer face at Madras be made sloping by masonry additions? Struts, &c., on the land side provide extra resistances, but the sea round slope is a more radical cure, as it abolishes the over-turning force altogether.

H. I. G (Assam) wtites:—I shall be glad to learn, through the medium of your columns, whether a stationary or portable boiler can be properly and efficiently tested by disconnecting the slide valve, eccentric and connecting rod big end, and working the feed pump on the engine by keeping the fly wheel in motion manually. Any information upon this subject will meet with many thanks.

Literary Notices.

TRANSACTIONS AND PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS. August and September. 1886.

Contents:—August number, "On the work done for the Preservation of the Dam at Holyoke, Mass., in 1885, and some Studies for a New Stone Dam for the same place," by Clemens Herscheli. September number, "Evaporation," by Desmond Fitz Gerald.

TRANSACTIONS OF THE INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND. November. 1886.

This number contains the discussion of Mr. J. W. Macfarlane's Paper on "The Safety Governor," which was resumed and terminated, with a vote of thanks awarded to the Author. Also the discussion of Mr. Robert S. Moore's Paper on "The Construction and Laying of a Malleable Iron Water Main for the Spring Valley Water Works, San Francisco," which was resumed and afterwards adjourned for further discussion at the next General Meeting. A Paper on "Erecting the Superstructure of the Tay Bridge," by Mr. Andrew S. BIGGART, C.E., was read, but the discussion being deferred to next General Meeting, it would be premature to refer to it in this notice.

RECORDS OF THE GEOLOGICAL SURVEY OF INDIA—Part 1, Vol. XX. 1887.

The chief interest which attaches to the present issue of these "Records" is due to the Annual Report of the Director, which will be the last from Mr. Medlicott, who shortly retires from a position which he has long filled with credit to himself and advantage to Science.

We glean from the *review* of the year that Mr. Foote has been deputed to report on some gold-fields in Mysore, at the solicitation of the local authorities, and Mr. Hughes to the Nizam's territories, to conduct exploration for minerals; both practical objects, for which it is right that the best knowledge and experience should be made available.

We purpose noticing the views of the Director on the employment of natives as geologists in an early issue.

The Field-Notes and other Papers that make up the volume are of the usual class of previous issues, and call for no special remark.

General Articles.

GARSON'S PATENT SUSPENSION BRIDGES

I ANNEX drawings of a peculiar type of Suspension Bridges recently adopted by the Public Works Department in the Darjeeling District over the Rivers Kohil and Pool Bazaar, each 70′ Clear Span, of which Messrs. A. W. V. J. Main & Co. of Glasgow are the sole manufacturers.

In constructing suspension bridges of the ordinary type for passenger and light traffic, the difficulty always presents itself of obtaining a structure presenting sufficient stiffness without a disproportionate increase of weight. The plan usually adopted is to introduce side girders, and this arrangement gives structurally a quite satisfactory result, but at an expenditure of weight which especially in small bridges tells seriously on the cost.

In the Patent Bridge now submitted, stiffness against deformation and vibration in a vertical plane is secured by bracing together the upper curved and the lower horizontal member of the bridge frame. In this way there is given to the structure a stiffness approaching that of the ordinary girder bridge, while at the same time by the disposition of the bracing it is so secured that both the upper and lower members shall be subjected to tensile stress.

There is one particular distribution of the load which causes an exception to this latter statement, due provision for which has been made in the design.

The stresses on the diagonal bracing, moreover, are very small owing to the fact that the stress which comes on the ordinary girder with horizontal booms, is largely taken up by the curved upper chain in this pattern bridge.

The distribution of stress in Garson's Patent Bridge is therefore entirely different from that of the ordinary suspension bridge and manifestly the structural arrangements will not bear comparison with other structures in like respect.

Speaking generally the distribution of stress in this Patent Bridge is as follows:—

Upper Chain.—Stress at centre equal to zero increases towards piers when it reaches a maximum.

Lower horizontal Member.—Stress at abutments equal to zero increases towards centre of bridge when it reaches a maximum.

Diagonal Bracing.—Stresses almost the same horizontal and of small amount.

The bridge is hinged at the centre, so that it can rise, and fall as a whole with variations of temperature.

The piers are constructed of wrought iron or steel and are of H shape, or other suitable section, and being hinged at the base and connected at the summit, the stress on them is always axiel. Indeed, the function of the piers is simply that of struts which, being hinged at the ends, are subjected to no bending moment.

Consequently the stress on the foundations is purely of the nature of a vertical load. The foundations, therefore, should present no unusual difficulties, if indeed they are not more simple than in the case of an ordinary suspension bridge.

What is claimed for the design is that, in every point it fulfills the most stringent conditions of engineering efficiency, while the weight and cost are much lower than for a corresponding bridge of the ordinary principle.

Each bridge to suit 70 feet clear span, between abutments, consists of 6 feet wide clear roadway of 4″ thick planking running longitudinally on, and fixed with bolts to, 18 rolled cross girders 4″ × $1\frac{3}{4}$″ H section. These are supported by *double* channel iron longitudinal girders $4\frac{1}{2}$″ × $2\frac{9}{16}$″ at each side, supported by ties, struts, and suspension chains, as shown in drawing, carried on pillars at each end of bridge. Each pillar consists of one rolled girder column 8″ × 5″ H section with cast-iron socket and anchor bolts for fixing into concrete foundation; cast-iron "head piece;" and flat iron back ties connecting to steel wire rope $1\frac{1}{2}$″ diameter anchored with cast-iron plate at back of large concrete block having shackle for adjustment. The $\frac{3}{4}$″ diameter wind ties run diagonally from alternative cross girders as shown by "part plan" in drawing. The handrail on each side of bridge, is 4 feet high and formed with tube-rail at top $1\frac{1}{4}$″ external diameter having three lines of $\frac{3}{4}$″ diameter round bars below ditto running through $2\frac{1}{2}$″ × $2\frac{1}{2}$″ × $\frac{3}{8}$″ angle iron standards at about 4 feet centers apart bolts, nuts, &c.

From the general plan for a bridge of 70′ span, on Mr. Garson's Patent, and the diagram of strains for the same, furnished herewith, the essential features of the design and the mode of distribution of stress in the different members of the frame will be easily understood, and I feel sure that a thorough enquiry into the distinctive features of the design, will satisfy Engineers of its perfect safety and of the advantage it presents in respect of economy and simplicity of construction.

The cost of one of these Suspension Bridges, 70′ span × 6′ wide, delivered in Calcutta, is £125, the weight being 137 cwt. D. E.

IRON IN ARCHITECTURE.

ACCORDING to Ruskin and the old authorities Architecture proper allows the use of no Iron, except for clamps in joining stones, and works of similar nature; but the introduction of Iron so largely in the present day in structures has caused quite a revolution in Architecture, the same way as that bastard order "Composite" did in Classical Architecture. No one even argued that it ever looked so beautiful as the regular orders—Tuscan, Doric, Ionic or Corinthian, yet it was found to be a necessary evil; it met the requirements of the day, and ultimately became a recognised order. The same may be said of Iron, for no iron bridge of large span, looks so graceful as a semi-elliptical one of the same span of stone, or even brick, yet the cheapness and facility with which the former can be constructed, causes it to be universally adopted. The word "Architecture" ought to have a more liberal meaning in the present day, and should imply the construction of a structure to meet the requirements for which it is intended, irrespective of the material of which it is built, but in conformity with the rules and science of engineering. It is by the abuse of these rules that we are able to distinguish the Architect from the Modern Builder. However, some of the latter have so excelled in their trade, and have turned out such handsome structures by simply following the rule of thumb, that it is only when we come to *Restoration* that we can generally find their weak points. How often have our feelings been outraged, by seeing a corrugated iron roof put on an old Norman Abbey, iron girders substituted for old oak beams, and interior walls, which have become mellowed by age, ruthlessly whitewashed? Now, in "Restoration," there is no objection to using iron, or even iron griders, provided they are not seen; and in modern buildings no one would think of having vaulting, which would necessitate thick walls to bear the thrust, where they could have an equally substantial structure by the introduction of iron girders and thinner walls. The superiority of Iron for utilizing the greatest strength with the least material when compared with stone is about the same as comparing the motive-power of steam or electricity with hand-power. The rule for its adoption should, therefore, be:—By all means use iron in your design, for it is a necessary evil, but let it be distinct and characteristic, and plainly imply what it is intended for; do not substitute cast iron columns to Norman arches or put in iron tie bars to brace up the cracked walls of same where you can use buttresses. It is in this point that the Architect rightly discriminates between harmony and discord, and the Builder fails.

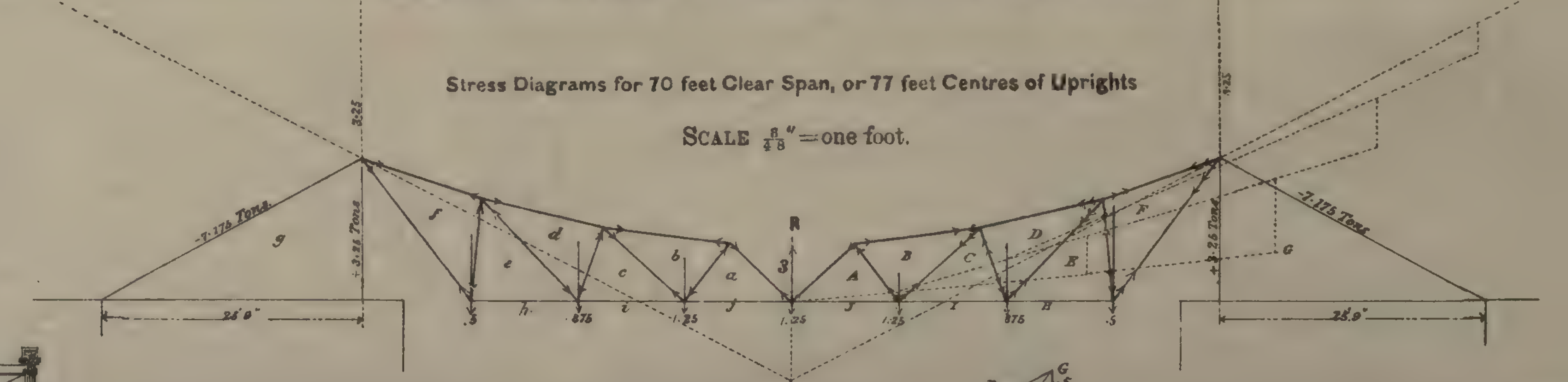
Had Michael Angelo or Christopher Wren understood Iron, or rather had the facilities of working it as we have in the present day, he would have acknowledged its necessity as all *Modern* Architects do. G. F. B.

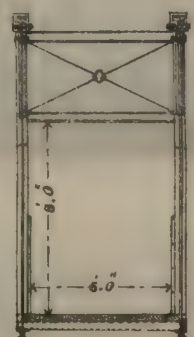
Less than one-fourth of the people in Australia are Roman Catholics, but the organisation of their Church is very perfect; and their buildings are built not for years but for centuries. St. Mary's Cathedral in Sydney, and St. Patrick's in Melbourne, will probably be the finest buildings which future Australia will be able to show. In a few years, when the high spire is added, there will be few buildings in the British Empire grander than the latter.

GARSON'S PATENT STIFFENED SUSPENSION BRIDGE.

Stress Diagrams for 70 feet Clear Span, or 77 feet Centres of Uprights

SCALE $\frac{8}{48}''$ = one foot.



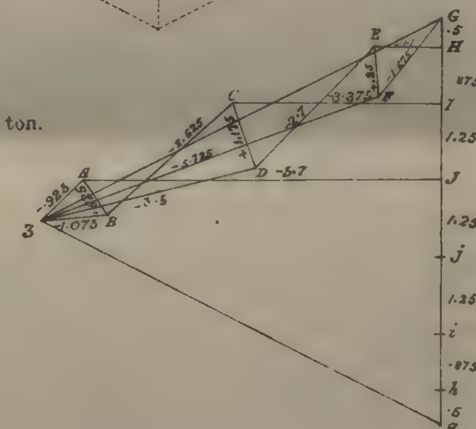


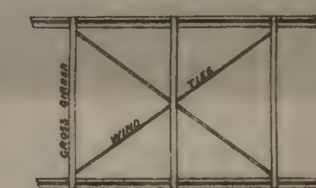
Cross Section.

Dead load = 8 tons.

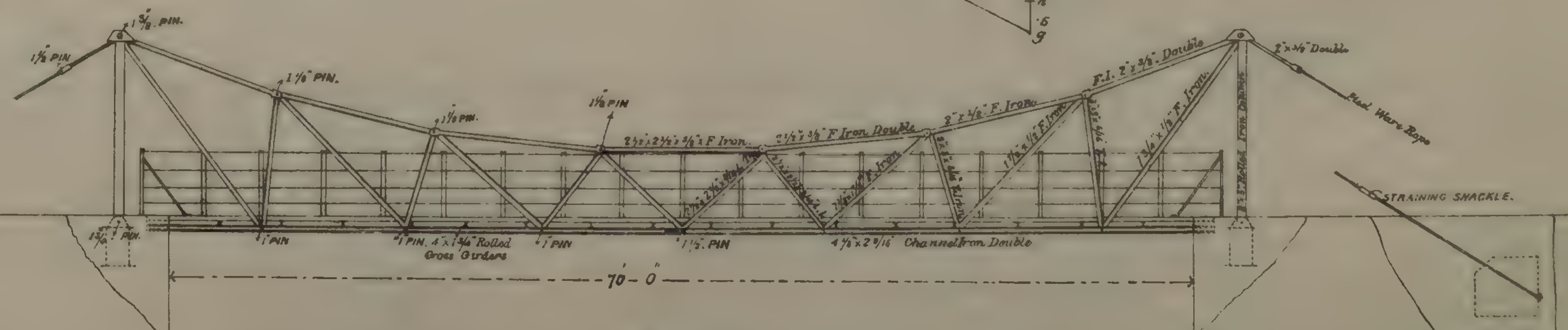
Live load = 6 tons on 4 Central Bays.

SCALE $\frac{1}{5}''$ = 1 ton.





Part Plan Showing Wind Bracing.



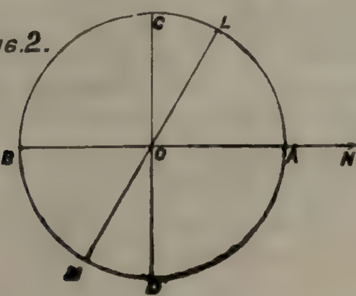
Elevation.

ON "DRIFT" IN GUN FIRE.

By A. Ewbank, M. A.

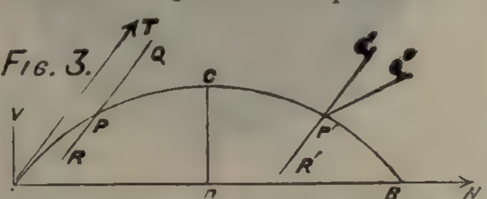
(Continued from page 69.)

Fig. 2.



In figure 2, M L is any line drawn in the same meridian plane C O A. A spin of the sphere (or otherwise shaped body) about this line M L—a spin supposed clockwise as seen from a point in L M produced—can be replaced by a spin about O A and a simultaneous spin about O C. The magnitudes of these spins will depend partly on the amount of spin about M L and partly on the angle L O A. The spin about O C will be counter-clockwise as seen from above C, and the spin about O A will be clockwise as seen from a point in O B produced.

Fig. 3.



In figure 3, which, of course, is not drawn even approximately to scale, A is the point from which the projectile is fired and A T the initial direction taken by it. Then the projectile is rotating initially about this line A T. Therefore, by what precedes, we may give to the body (instead of the rotation communicated by the rifling of the cannon) a clockwise on right-handed spin about a line always parallel to the north line A B and a counter-clockwise spin (as seen from above) about a line always parallel to the vertical A V. R P Q is the axis of the body at some subsequent time, and the spin about it will be replaced by spins about a due north line through P and A about a vertical through P. We may suppose P to be the centre of gravity of the body.

Now the rotation originally given tends to keep the line R P Q (which we call the "axis of figure") fixed in direction. Nevertheless, during the flight, forces act on the body tending to alter the direction of the line P Q, and the body must, to some extent, acknowledge these forces and so have the direction of P Q changed. When P Q changes its inclination to the horizon the horizontal and vertical spins (which we take instead of the original spin) will change in magnitude and in their ratio. If P Q so alters its direction that when the body reaches P′ the axis of figure takes a direction P′ Q″ instead of a direction P′ Q′, this change is beneficial in the case when the projectile is not spherical, but elongated in the direction P Q. But in the present discussion we omit for the sake of simplicity the consideration of the changes produced by air resistances or other causes in the direction of the axis of figure. Our reasoning is qualitative rather than quantitative. If, with a constant direction for P Q, and a constant amount of spin about P Q, we can detect a real cause for "drift," then this real cause will continue to act (though in a different degree) when changes either small *or* large take place in the inclination to the horizon of the axis of figure and in the amount of spin. As regards the path A C B of the centre of gravity of the projectile it is often stated to be a parabola. The authors, however, who make this statement are well aware that it is only roughly accurate. If the curve were a true parabola, the path would lie in one plane, that is, there would be no drift. Also, C being the highest point, the velocity of translation—or what we may call the forward velocity—would be less than anywhere else in the path. This is not necessarily the case. If P and P′ be two points at the same height above the horizontal plane through the starting point, the velocity at P′ for a parabola would equal that at P. This is never the case in practice. In the parabola the *curvature* at C, the highest point, is less than at any other point between C and B. This also fails to be the case in the actual path described. We merely note these differences between the properties of the parabola and the properties of the actual path or orbit in order to introduce the remark that our reasoning on the "drift" does not require us to study the real form of the curved line A C B.

We may now apply our gathered conclusions to the problem before us.

The body on being fired rises in the air till it reaches some point C. It then sinks till it strikes the ground at B. The ground in the neighbourhood is for simplicity supposed to be horizontal. If D be vertically under C, the length A D is in practice greater than the length D B. We first proceed to consider the nature of the drifts between A and C. We shall find it less appreciable than it is between C and B.

At any point P the forward velocity, or velocity of translation, may be replaced by a certain horizontal velocity and a certain vertical velocity. We have then at P two translation velocities and *two* angular velocities. Out of these and the density of the atmosphere the "drift" results.

Consider first the vertical upward translation velocity. This condenses the air on the *upper* part of the projectile and causes a rarefaction of the air immediately *under* the projectile. As we are only aiming at qualitative results we will suppose the body spherical. The clockwise rotation about a horizontal due north axis causes the upper parts of the sphere to have in their motions an *easterly* (*i.e.*, eastwards) element or component. The under half of the sphere has a westerly motion. The *friction* of the air against the upper half of the sphere gives a resisting force which acting on the body (as if at the centre of gravity) causes the body as a whole to move out of the meridian towards the *west.* The friction of the air on the under half of the sphere is a reactive force which tends to make the body as a whole deviate to the *east.* But the friction at the top where the air is condensed by the vertical upward movement of the centre of gravity is greater than the friction underneath from the rarefied air. Therefore, so far as this cause *alone* is concerned, the centre of gravity should deviate to the *west.*

With this same clockwise spin about a horizontal due north axis we have now to combine the forward due north horizontal velocity of the body as a whole. In this case the friction above and below are equal and opposite in their tendencies. They have, therefore, no effect in causing the body to "drift." On the whole, therefore, the *total* translation velocity at P *combined* with the clockwise component angular velocity about the horizontal axis due north causes a drift *west.*

Next, consider the spin about a vertical line through P. The horizontal forward velocity condenses the air over the *front* half of the sphere and rarefies air at the back half. The spin causes friction in front between the sphere and the condensed air and friction behind between the sphere and rarefied air. This counter-clockwise spin (as seen from above) gives to the points in the front hemisphere westerly motions and to the points behind it gives easterly motions. The *front* friction (which opposes the movement) is therefore eastwards and the friction over the hinder half is westwards. The former (from condensed air) exceeds the latter. Therefore, the spin about a vertical axis combined with the horizontal forward velocity causes a deviation or "drift" eastwards.

This same spin about a vertical axis combined with the upward translation velocity gives on the front and back hemispheres (*i.e.*, on the north and south hemispheres) equal and opposite frictions. These, therefore, cancel each other. Therefore the whole translation velocity

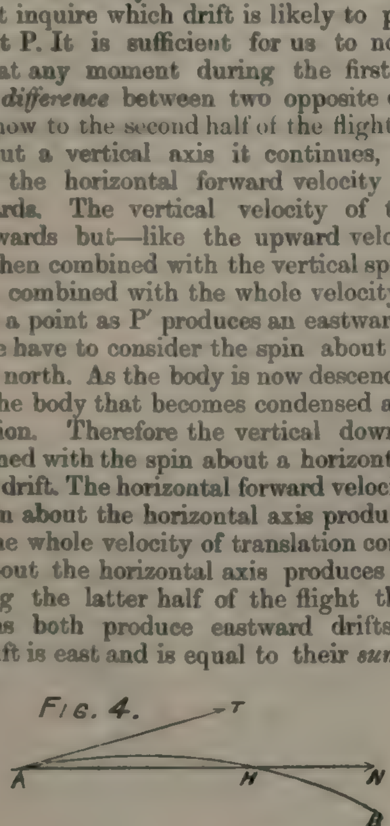
at P *combined* with the spin about a vertical axis gives a drift eastwards. We have now completed the examination of the interacting causes for the first half of the flight of the projectile, *viz.*, that part of the curve along which the projectile is rising. We have used the expression first half of the flight, though the actual time for the rising motion will not be exactly equal to that for the sinking motion.

We see that during this first half of the flight the component angular velocities tend to produce drifts in opposite directions. We have therefore three cases. The east drift may preponderate, or the west drift may preponderate, or they may be equal, in which case the body keeps its vertical plane of motion. The equality between the drifting tendencies is not likely to be more than momentary. We need not inquire which drift is likely to preponderate at any point P. It is sufficient for us to note that the actual drift at any moment during the first half of the flight is the *difference* between two opposite drifts.

We pass now to the second half of the flight. As regards the spin about a vertical axis it continues, when combined with the horizontal forward velocity to produce a drift eastwards. The vertical velocity of translation is now downwards but—like the upward velocity—it has this effect when combined with the vertical spin. Thus the vertical spin combined with the whole velocity of translation at such a point as P′ produces an eastward drift.

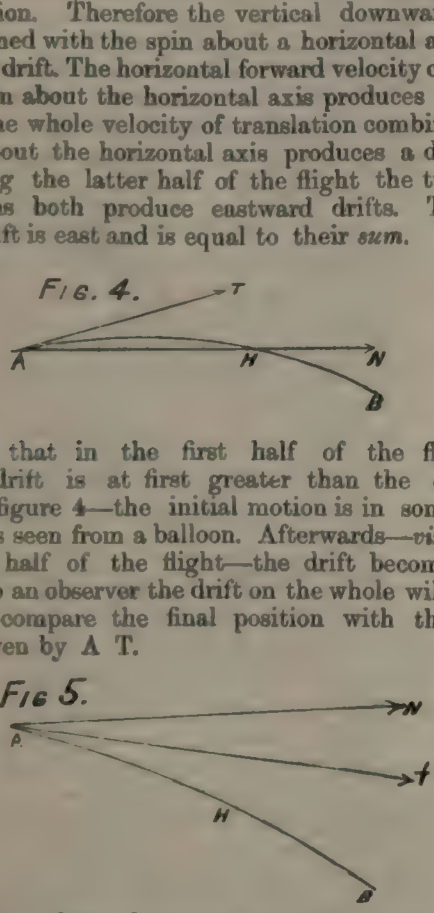
Lastly, we have to consider the spin about the horizontal axis due north. As the body is now descending, it is the air *under* the body that becomes condensed and gives the greater friction. Therefore the vertical downward movement combined with the spin about a horizontal axis gives an eastward drift. The horizontal forward velocity combined with the spin about the horizontal axis produces no drift. Therefore the whole velocity of translation combined with the spin about the horizontal axis produces a drift east. Thus during the latter half of the flight the two component spins both produce eastward drifts. Therefore the total drift is east and is equal to their *sum*.

FIG. 4.



Suppose that in the first half of the flight the westward drift is at first greater than the eastward. Then—see figure 4—the initial motion is in some direction A T, as seen from a balloon. Afterwards—*viz.*, during the latter half of the flight—the drift becomes east. Therefore to an observer the drift on the whole will be east, for he will compare the final position with the initial azimuth given by A T.

FIG 5.



In figure 5, where the eastward drift is supposed from the first to preponderate over the westward, it is equally clear that to the observer, who knows nothing of the component drifts and only recognises balance or net results, the final drift will seem east.

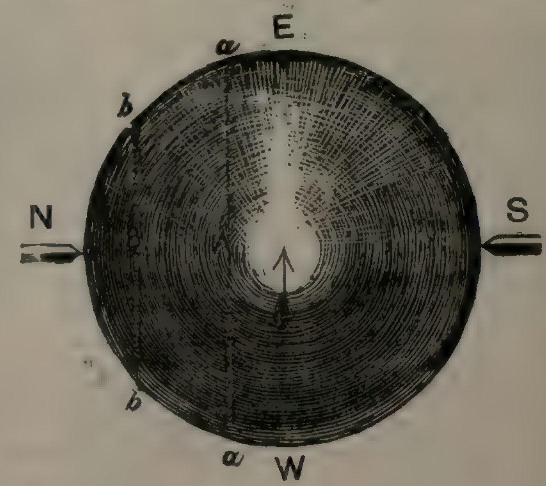
The foregoing analysis shows that the drift should be more marked towards the end of the flight. If, for example, we consider the component drifts at any time to be as 2 and 3, we have the sum five times as great as the difference. It will be useful if artillery officers reading this paper will endeavour experimentally to verify the conclusion to which pure theory has now led us.

In this discussion a certain delicate drift due to the earth's rotation, and not equally appreciable in all azimuths, has been left out of account. A. E.

"ON 'DRIFT' IN GUN-FIRE."

THE article on "Drift in gun fire," by Mr. A. Ewbank, in INDIAN ENGINEERING of 5th February, (to be continued), draws attention to a physical law which, in its effect, has a considerable influence on the direction of the flow of rivers, running from north to south in alluvial plains. It has been especially noted in its effect upon the rivers of Russia and the Punjab, and was first noticed by Herschel in its effect upon air currents.

The writer of the article to use a word constantly repeated by him *spins* it out to too great a length to be of much service. Allow me to make a *maiden* effort to put the cause of "Drift" more consisely before your readers.



The above figure represents the earth revolving on its axis N S from W to E. It is evident that a point on the earth's surface at A revolves faster than a point on the surface at B, inasmuch as A revolves from *b* to *a* in the same time that B revolves from *a* to *b*.

A projectile fired from A in the direction of B will start from the muzzle of the gun with the circumferential velocity of that point A, and will continue to have that circumferential velocity until it comes to a state of rest, retarded only by the friction it meets with in its movement eastward against the air, or in touching the ground, which at any point north of A is moving eastwards at a slower rate.

If it is doubted that the projectile does not continue to have the circumferential velocity of its starting point, that is the gun; let any of your readers take a few pieces of stone in their pockets the next time they travel by train, and as they move at 20 to 25 miles an hour aim steadily, throwing as hard as they can at the telegraph posts (first seeing that there is nobody near), and they will find that each stone touches the ground some twelve to fifteen feet forward of the telegraph post. Then let them pitch the stone lightly high up in the air endeavouring to pitch it on to the top of the post. They will find that the stone will first touch the ground half way to the next telegraph post, and approximately opposite to their railway carriage.

The rule to find the extent of "Drift" is based on the difference between the circumferential velocity of the starting point and that of the terminating point and the time taken in passing from one to the other.

The retardation owing to increased velocity eastwards over surrounding particles of air or water, is omitted as being infinitesimal in the case of a projectile passing through air, and not exceeding five per cent. of the "Drift" in the flow of water in rivers.

The circumferential velocity of the earth's surface at the Equator being 1,520 feet per second, the difference of the circumferential velocity at any two points in one second of time is 1520 (Cos A—Cos B.)

At 52 degrees latitude, in England, the difference for each mile of latitude is 0·30 feet per second, and at 30 degrees latitude, in India, the difference is 0·19 feet per second.

T being the time in seconds, the formula for finding the "Drift" for any angle east or west of north per mile of distance M in England and the Punjaub may be stated as follows:—

England:

Drift = M·30 T. (Cos ∠ E or W of N and S) in feet.

Punjaub:

Drift = M·19 T. („ „ „) „

Example I. Required to find the "Drift" eastward of a projectile fired in a direction 10 degrees west of north at a target $1\frac{1}{4}$ mile off. Time of passage being 3 seconds.

Drift = $1·25 \times 3 \times ·30 \times ·98$.

= 1·09 feet = (approx) 13 inches.

This is surely a measure that must have met with attention from artillerists both in India and England.

The drift in the Punjaub under the same circumstances would be about eight inches.

Example II. Required to find the "Drift" westwards in the flow of a river in one mile, with a natural course from N. N. E. to S. S. W. moving at the rate of five miles per hour, that is, one mile in 12 minutes or 720 seconds.

"Drift" westward in feet = $·19 \times 720 \times \text{Cos}22\frac{1}{2}° = 131$ feet.

It will be noted that if the direction of the fire or flow of the river is from north to south, the "Drift" will be westwards; that is, again referring to the figure of the globe, the projectile starting from B, has the lower circumferential velocity, and during the time of passage from B to A, the target has passed to the eastward, and the projectile strikes to the rear—that is, the westward of its path.

Much might be written on the effect of this physical law in the erosion from the west bank of the rivers of the Panjaub, and the destruction of towns standing on that bank; also on its influence on air and ocean currents—especially in high latitudes; but any further remarks may well be left for a future occasion.

J. E. Hilton, M. Inst., C. E.

THE SINGARINI COALFIELD.

Frequent allusions have of late years been made to this field in the public prints and otherwise, and as just now considerable interest seems to be attracted to the *locale* consequent on the arrangement recently concluded by the Nizam with the Hydrabad (Deccan) Company, the occasion is most opportune, I think, to treat your readers to a brief account of the field and the magnitude of the concession made to the Company named.

The field under notice is a small outlier about 30 miles south-west of the main field in the Godavari Valley, and derives its name from a village situate in the Hydrabad territory, near which the coal was found. Its area is estimated at 19 square miles, of which the coal measures represent 8 square miles. The groups met are Kamthis, Barakars and Talchirs. Several borings were executed by the Government of the Nizam some years since, and the result proved four seams of varying thicknesses and qualities—one of them being 50 feet thick but of indifferent quality. About six years ago, 300 tons of the coal were mined and sent for trial to Hydrabad, where it was found to be suitable for portable engines and smithy purposes. It was also tried on the Madras Railway with favourable results, but its cost proved a bar to its adoption there, in preference to patent fuel. The consequence of this, and the want of a properly organised scheme, led to the abandonment of the workings, which are now taken advantage of by the Hydrabad (Deccan) Company.

Three years ago negotiations were initiated by the Company named with His Highness the Nizam's Government for the acquisition and working of the mineral deposits of his dominions. After considerable delay, caused through the interference of the Home and Indian Governments, the treaty, which hung fire so long, resulted in the unparalleled lease of 99 years!—under which the Company became the sole and exclusive proprietary of the country's enormous mineral wealth.

Thereupon, no time was lost by the Company in entering upon the work of development, and to that end they appointed Mr. Molesworth, C.E., to the management of the colliery. Since the assumption of his duties and during the short space of 12 months or thereabouts, he has succeeded in re-opening the old workings, which are reached by a pit or shaft about 47 feet deep. The seam here dips one in six, and is 7 feet thick, of which 6 feet is fairly good coal. It has good sandstone roof and sound thill, watering sparingly, and requiring no timbering. The winding is done by a 10 H.-P. engine and the coal raised in large skips. Provisions are in progress for establishing an efficient ventilation of the workings, including a new pit in course of sinking. The diameter of this pit is 16 feet in the clear or about 10 feet larger than the old shaft. No difficulties are anticipated in sinking the new shaft, which is expected to strike coal at the depth of 100 feet from the surface.

The coal put on the bank just now costs about Rs. 2 per ton, and as the men get accustomed to the work and operations extend the charge on the output will be proportionately less. Mr. Molesworth expects to have 7,000 tons of coal ready against the connection of the colliery by rail with the Hydrabad and other systems of Railways. When this is done, over 4,000 miles of Railways will be brought under the glorious influence and operation of cheap fuel. The consumption on this extent of Railway cannot be less than 200,000 a year, and, adding to this 150,000 tonsmore, as the annual requirements of thousands of industrial and manufacturing establishments dotted all over the country within the serviceable limits of the Singarini coal, the figure commands some attention.

I hope to see this field doing what it expects to do—as much as the Karharbari or the Bengal areas; but this will be a work of time. The Karharbari is doing about 400,000 tons a year, having been in active operation for over 16 years, and the Bengal, whose out-put is twice as large, during the last 30. There is evidently a desire on the part of the Deccan Company to introduce English miners instead of trusting the work to local men. A greater mistake could not be made, and the sooner the Company abandons the idea the better. All that is wanted just now and in the far future are two or three experienced men to teach the natives and conduct the underground works. The English miner at an actual operation would not work longer than a month, after which he would chuck it up and return to the Old Country.

I may state that besides coal, the dominions of the Nizam, which are larger than the whole of England and Scotland put together, abound in iron, copper, corandum, cornelian, garnet, gold, diamond and other precious metals and stones. The famous Kohinoor now in the possession of Her Most Gracious Majesty, the Queen of England, is said to have come from Golconda, situate in this territory.

The Government of India has, I understand, placed the services of Mr. Hughes, of the Geological Department, at the disposal of the Hydrabad (Deccan) Company, with a view to thoroughly explore and examine the country and report on its economic value. I also hear of the arrival of an expert in diamond digging, who will report on the diamond field after careful examination and practical test.

It is the intention of the Company to turn the valuable iron deposits of the country to profitable account by establishing iron and steel works and manufactories. Bountiful Providence has placed the ingredients in close proximity to one another, and labor, which is an important factor in all undertakings of an extensive character, is abundant and cheap. With these natural advantages, adjuncts, and accessories, I cannot see the reason why India should not be in a position at no distant date to supply her own requirements of Railway and other materials.

M. E.

TESTING THE HOOGHLY BRIDGE.

The Hooghly Bridge has been tested on the 17th and 18th instant, and we hope to be able to give the actual results to our readers in our next issue. The Viceroy opens the bridge formally for traffic, on Monday, the 21st instant. We understand that the tests taken were threefold on each large span, *viz.*, the standing, ten miles an hour, and twenty miles an hour tests. Three points in each span were tested, and they are illustrated in the diagram given below.

A is the point of junction between the cantilever and the shore girders, B is the centre of the whole span from the viaduct to the first pier, and C is the centre of the shore girders. For the purpose of the standing test, a fully loaded goods train, with two heavy engines in the centre, was brought into the track, the two engines resting over the point to be tested, and the whole of the rest of the span being covered with fully loaded goods waggons. Four observers were posted at each end of the bridge, four of whom took the oscillation readings by means of theodolites, and the remaining four the deflection readings with levels. After the girder had been loaded long enough to take its full permanent set, the train was run off the bridge, and then sent across, first at the rate of ten miles, and afterwards at the rate of twenty miles per hour, during which observations for both oscillation and deflection were taken at the points A, B, and C in both spans of the bridge. It was intended, if both tracks could be got ready in time, to complete the tests by running two passenger trains of 19 or 20 carriages (equipped in fact similarly to an ordinary mail train) in opposite directions across the bridge at express speed. We hope, as we said before, to be able to give the results of all the above tests to our readers in our next issue.

The method adopted is in our opinion a rough and ready one, although for practical purposes it may be accurate enough. It would, however, have been very interesting to have obtained absolutely accurate tests, so far as the deflection of the bridge at any rate is concerned, and that might have been done by adopting the ingenious method described by M. Emil Sokal, in Vol. LXXXV of the Minutes of Proceedings of the Institute of Civil Engineers, July 1886. In this case the bridge spans were only 350 feet each, and there were but two openings, whereas in the case of the Hooghly Bridge the two shore openings are 560 feet in span. The former bridge is on the railway from Kotzlow to Moscow, and it was considered necessary to take careful measurements of the deflection, on account of some alleged carelessness in the erection. To erect a staging underneath the girders was too expensive, on account of the great depth of the river, and readings with a level were not considered satisfactory, on account, we presume, of their not being held to be sufficiently accurate. Now, it should be borne in mind, that the Russian Engineers thought level readings unsatisfactory for a maximum distance of 175 feet, half the span of their girders; on the other hand, the Consulting Enigneer for the East Indian Railway apparently considers that the results given by a level are sufficiently accurate up to a distance of 420 feet—the distance of point A from the abutment, or nearly two and a half times the distance in the first case! We do not presume to say who is in the right in this matter, but we cannot help saying that our preference lies with the superior accuracy of the Russian Engineer, and we are confident that any eminent Continental Engineer would have carried out these most important and interesting tests in a more careful and exact manner. The method adopted in Russia was most simple and ingenious, and is thus described in the Minutes of the Institute.

"An iron pipe, 1½ inches in diameter, was carried along the outside of one girder, resting upon angle-irons riveted to the underside of the bottom flange of the girder. From this pipe—at each abutment, at the pier, and at five intermediate points on each span—vertical pipes of the same diameter branched out, the joints being made absolutely watertight. Inside and near the top of each vertical pipe was fixed a graduated glass tube, ¾ inch in diameter, the iron pipe being cut away on both sides, to allow of the height of the water in the tube being observed. The divisions on these glass tubes were such that the zero point in all was the same distance above the flange of the girder, and when this was horizontal, all the zero points were in a straight line. Before the bridge was loaded, the apparatus was filled with water, the tops of the upright pipes were covered over, and the water was then drawn off till it stood at 0 at each of the glass tube gauges.

"On the bridge being loaded, the deflection at any point could be at once read off with great accuracy."

We are quite unable to understand why this ingenious method of testing for deflection was not adopted in the case of the Hooghly Bridge; the oscillation tests, which were taken by a theodolite, were in all probability correct enough, on account of the superior accuracy of the instrument.

C. E.

GAUTHIER'S NEW PROCESS FOR TREATING COCOONS AND NEW APPLIANCES FOR REELING THEM.

This invention relates to a new method of stifling and drying the chrysalis in a suitable chamber by means of steam and hot air in manner hereinafter described; also of softening tusser and other wild cocoons by a solvent or disintegrating fluid, also of maintaining the tusser and other wild cocoons in a proper condition during the process of reeling silk therefrom, and also of drawing with uniform tension and cleaning separately the fibres of the cocoons and agglomerating the same into one thread before the silk thread is wound on the reels or spindles.

The means used in Europe for stifling the chrysalis of the cocoon consists of a chamber into which steam is introduced, or in which hot air is generated from furnaces, and the defect in the processes so employed is, as regards the use of steam, that the chrysalis is stifled, but the tissues of the cocoon are not dried; and as regards the use of hot air, that the temperature obtained from furnaces cannot be properly regulated and the consequence is, that a portion of the cocoons (or one side thereof) is often burnt and thereby destroyed.

The means of feeding the apparatus in Europe with cocoons and withdrawing them is also slow and defective.

According to this method which serves for stifling the chrysalis of mulberry, as well as tusser and other wild cocoons, there are two chambers, an outer and an inner chamber, both constructed in masonry. The drawing No. 1 shows the stifling and drying apparatus, and its dimensions, by scale, designed for 1,000 kilogrammes of cocoons.

As shown in the said drawing, the apparatus consists of one chamber (B1) within which is constructed the second chamber (B2) separated from the first by a space (E) and connected with the first chamber by means of valves (H1 and H2) fixed in the walls (B2 and H3) in the floor (F1) and in the ceiling (F2) of the inner chamber, which valves are opened and shut at will, by means of handles affixed at the end as represented.

The chamber (B2) of the apparatus is fitted with shelves on which to place baskets containing the cocoons, with rails on which to run trolleys for receiving baskets containing cocoons: and these are used for readily supplying the cocoons to the apparatus, and for the same purpose doors are constructed at one end of the apparatus, or both ends of it if preferred. The shelves are indicated in the drawing No. 2. as (L2) and the rails and trolleys as (L1). By having doors at both ends, much time is saved as the withdrawal of cocoons is effected at one end, and the entry of them is effected at the other end.

The arrangement of the valves allows for the regulation of the ventilation in the inner chamber from all

Nº 4.

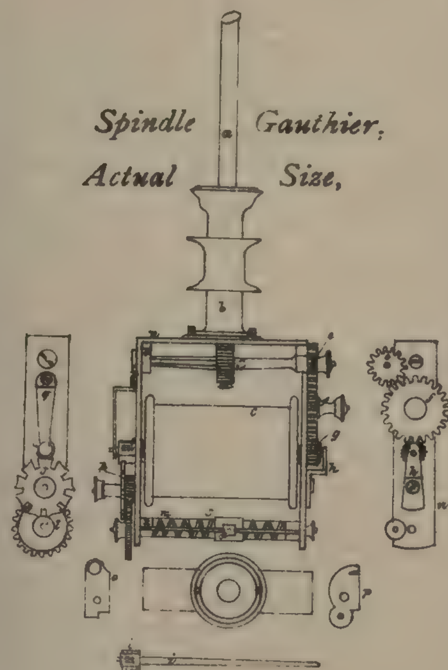
…LE.
…which turns the spindle.
…lle and revolves round the fixed rod.

A.—Reel. …takes its movement from the endless screw
B.—Wheel turned by friction …
a.—Motive shaft. …t from the shaft d to the wheel f.
C.—Pulley for the movement …gt to the pinion g.
D.—Stopping lever. …the shaft i from the bobbin c.
E.—Transmission to the rod
forward movement et. …movement to the wheel j.
F.—Ordinary sweating basin …the pinion k to the wheel l.
G.—Cocoon threads ascending …
movement.
H.—Felt cylinder for cleaning …
I.—Brush. …e spindle.
J.—Tube for the liquid for de…ating the friction of the pinion a, against

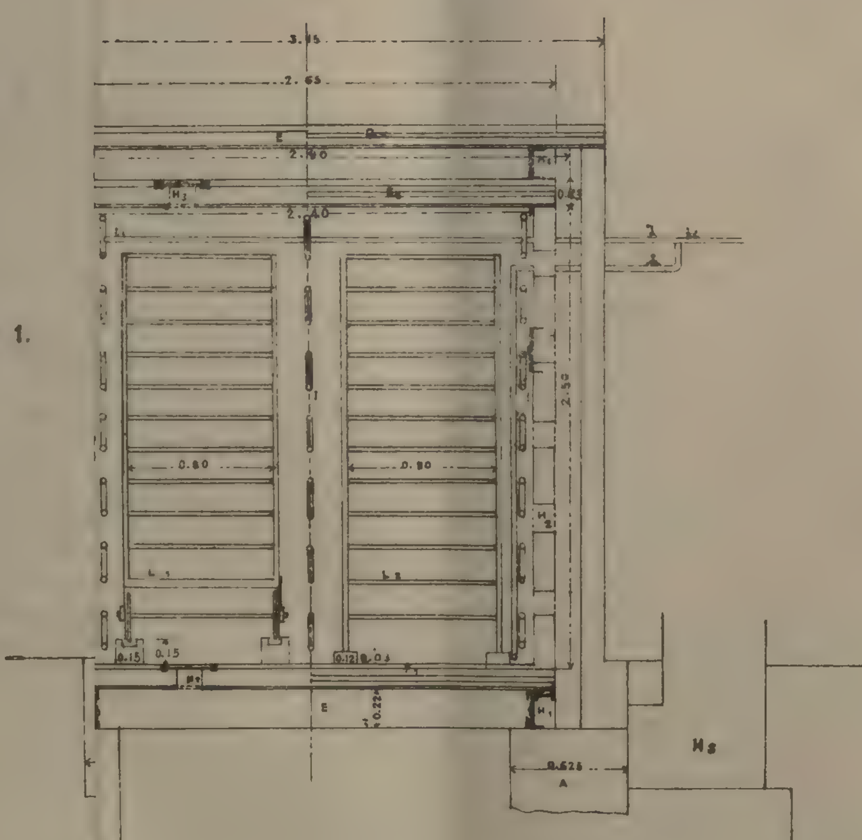
…vond the frame.

…ckets.

Spindle Gauthier; Actual Size,



Nº 1.



Vertical tranversal Sections.

…S IMPROVEMENTS FOR FILATURES.

The "STAR" Press, 19 Lall Bazar Street, Calcutta.

sides and in all parts and directions. The air is introduced into the apparatus by means of the entrance valve (He), and is passed out by means of valve (Hs.) The introduction of the air is obtained by an aspirator adapted to the egress valve (Hs) of the apparatus or in communication with any large chimney of the works, serpentine tubes (I) in 3 rows communicating by means of the tap of the tube (J1) and receiving the steam directly from a boiler give the necessary heat for the operation of stifling the chrysalises by hot air; and the operation of stifling does not exceed 45 minutes and the complete desiccation of the chrysalises of the cocoons is accomplished in about 16 to 18 hours for the mulberry cocoons and from 30 to 35 hours for the wild cocoons. This system of desiccation is patented also for the purpose of drying any kind of merchandise such as wool, cotton, starch, tea, tobacco, &c.

In order to maintain the required temperature, the ventilation is regulated by means of the valves He, Hs, H1, H2, H3, as many or as few of which can be opened or closed according to the temperature shown by the thermometer to be suspended in the chamber (B2). The proper temperature is from 200° to 210° Fahrenheit.

The solvent or disintegrating solution is used only for tusser or other wild cocoons, not for mulberry cocoons. It consists of ordinary potash, natron or bicarbonate of soda, wood-ashes and chrysalis water in the proportions indicated in the specification and of linseed, castor, mustard or other vegetable oil.

The improvements in the reeling of tusser or other cocoons are partly shown in drawing No. 3, and they consist of a cylinder or roller (H) enveloped or covered with broadcloth, flannel, India-rubber or other similar material. The said cylinder (H) is damped with agglomerating liquid and is also cleaned by means of the cylindrical brush (I). When the cocoons to be operated upon are ready, the joined thread from the silk of the required number of cocoons are passed through the "chambon" croisure or tavelettes (which are made adjustable) and it then goes to the reels A, which may be of any diameter. The said reels can be turned by friction by a steam engine or by hand, each spinner turning his own reel.

Drawing No. 4 represents an improved apparatus for doubling, twisting and reeling the raw silk or tram.

G. De P.

RANGOON DRAINAGE PROJECT.

(Continued from last issue.)

SPECIFICATIONS FOR AIR COMPRESSORS, STEAM ENGINES AND BOILERS, FOR SEWERAGE WORKS.

Air Compressors.

THE Air Compressors to be of the type known as Sturgeon's "Trunk" Air Compressors, with Shone and Ault's improvements thereto.

The Air Compressors to be vertical, on strong cast-iron box standards, and to consist of two single-acting cylinders, 24¼ inches diameter, bolted securely to the standards, as shown in drawings, and fitted with water jackets of sheet iron screwed round the cylinders.

The cylinder ends to be movable, and to act as outlet valves, as shown in drawings.

The two single-acting pistons to be securely bolted together by wrought-iron piston rods, connected to a centre cross head.

The pistons to be fitted with cast-iron piston rings pressed outward with spiral springs.

The inlet valve to be in the centre of the pistons, and connected together with a valve spindle in such a way that one of the valves must always be open when the other is shut.

The valve spindle and inlet valves to be balanced by a spiral spring, just supporting the weight of the same.

The valve spindle to be gripped by a friction clutch with lignum vitæ bearings, and fitted with screws in such a way that the amount of friction can be nicely adjusted while the engine is running.

The piston to be moved by two wrought-iron connecting rods and by two cranks each of 18 inches throw.

The length of the compressing cylinders to be such as to allow the pistons 3 feet stroke without any clearance whatever.

Steam-Engines.

Each pair of single-acting air-compressing cylinders to be fitted with a double-acting, horizontal, compound steam-engine with injection condenser.

The high-pressure cylinder to be 19 inches diameter.

The low-pressure cylinder to be 34 inches diameter.

Both cylinders to have 2 feet stroke.

The piston rods to be of Bessemer steel of approved special quality, 3¾ inches diameter in front and 2½ inches diameter at the back.

The cross-head and guide to be made in one piece with the piston rod as shown in drawing.

The connecting rods to be best wrought-iron, forked in the cross-head end and with the crank end of the usual marine type.

The connecting rods to act on the same shaft as the air-compressing connecting rods, but on separate cranks. One of these cranks to be in the same direction as the air-compressor cranks; the other of these cranks to be at a right angle to the other three.

The pistons to be of the same description as the air-compressing pistons.

Both cylinders to have their sides carefully steam-jacketed. The steam-jackets to be supplied with steam direct from the boiler and carefully drained by the most approved form of steam trap.

The low-pressure cylinder to be fitted with three-way cock as an auxiliary starting vavle to admit boiler steam directly to the piston for starting the engine.

The slide valves to be moved by eccentrics, and both cylinders to have separate expansion valves on the back of the main valve formed of two flat plates whose distance from each other can be altered by means of right and left handed screw threads on the valve spindle to be adjusted by a hand-wheel on the high-pressure and nuts on the low-pressure cylinder while the engine is running, the degree of expansion being indicated on a scale.

The bed-plate of the engine to be heavy and substantial, 2 feet deep, the top 2¾ inches thick, the bottom having a strong rim 3 inches deep by 2¾ inches thick, all round the rest of the bed-plate to be ¾ of an inch thick.

The bed-plate to be securely bolted to a stone and brick-work foundation by strong wrought-iron foundation bolts, of the best quality, 1½ inches diameter, and the bed plate to have strong substantial lugs to receive them.

The engine to have a pendulum governor that will prevent excessive speed, but not to act under 100 revolutions per minute, the normal speed being 50 revolutions, the speed of the engine being regulated entirely by the pressure of the air in the mains; this pressure acting on a pressure governor which closes an equilibrium throttle valve, so that the greatest variation of pressure in the mains should never amount to more than two pounds per square inch.

The main shaft to be of the best approved description of Bessemer steel, 7 inches diameter, having four cranks, two for air compressor, with 18 inches throw, and one for each of the steam-engine cylinders, with one foot throw, as described above.

Each set of engines and compressors to be fitted with two fly-wheels 8 feet diameter, and weighing about one ton each.

The condenser to be fitted with an air pump driven from the main shaft by a 10-inch pulley and belt. The air pump cylinder to be 14 inches diameter, single-acting, with 6-inch stroke.

All circular joints in the engines and compressors to be ground together with emery, so as to fit steam and air-tight without any packing whatever.

All bolts, screws, and studs to be of best Swedish iron.

All parts of the engines and compressors to be fitted with the greatest care, and to be of the best materials.

The engines and compressors must be fully erected in the contractor's workshop, and tested with steam to the satisfaction of the engineers before delivery.

Steam Boilers.

For each set of engines and compressors one Lancashire boiler has to be provided, 26 feet 9 inches long over all; the boiler shell 6 feet 6 inches diameter, with two internal flues each 30 inches diameter.

The grate to be 7 feet long.

Each of the internal flues to be fitted with 7 Galloway tubes as shown in drawing.

The boiler is to have a steam dome 34 inches diameter and 42 inches high, to be provided with 2 safety valves, gun-metal stop valve, blow-off cock, 2 gauge glasses, 1 pressure gauge with flange for applying a control pressure gauge, and to have all the best usual fittings.

The front end of the boiler to be set back 9 inches in the shell and the space to be filled with silicate cotton or other non-conducting materials, as the Engineers may approve.

The end of the boiler to be covered by an easily-removable plate of sheet iron, over which the fittings project.

The fire doors to have planed edges so as to fit air-tight.

The ashpit to be closed air-tight by a movable lid.

Each boiler to have the usual dampers at the end of the two upper side flues.

The main flue to be fitted with one damper closing both boilers towards the chimney.

The boilers to be of the best wrought-iron plates. The fire-box of Lowmoor iron.

All rivet holes to be drilled in their places.

Each boiler to have two separate feed pumps, each to supply 300 gallons of water per hour.

The man-hole cover to be of wrought-iron, and the manhole to be surrounded by a strong wrought-iron ring riveted to the boiler shell.

The boilers to stand a working pressure of 80lbs. per square inch above the atmosphere, and to be in every respect of the best material and workmanship.

(To be continued.)

PUNKAHS:

A Lecture recently delivered at Bombay.

By J. Wallace, C.E.

The function of a punkah is to cause a current of air to pass the human body so that the animal heat may escape more rapidly. This has nothing to do with ventilation: for if the punkah were used in a closed room, it would still produce a cooling effect on the skin.

Let us for a moment examine into what takes place in this operation, for a clear idea of the cause of our sensations of heat is absolutely necessary to enable us to go directly to the simplest and best form of remedy. The heat we feel, and which sometimes renders us uncomfortable, is produced *within us* by the slow combustion of the food we eat.

This heat continues to escape from the whole surface of the body during the whole lifetime, and if anything occurs to arrest it to any great extent the result is fatal.

In cold weather, and especially when there is much wind, the animal heat escapes very rapidly from the body, and extra clothing is used, not for any heat it imparts, but simply because it interrupts the escape of the heat, and thus maintains the temperature of the skin,—that part of us which is most sensible of change of temperature. It is a wonderful fact that the heat of the interior of the body varies very little in a healthy man between India and Greenland.

The skin may bear a good many degrees of change of temperature with impunity, but the blood will only suffer a very small variation from the normal temperature of $98\frac{4}{10}°$ Fahrenheit without serious consequences.

Well, to keep the skin at an agreeable temperature in India we generally wear a minimum of clothing, and when there is no breeze we try to produce one with the punkah.

The escape of animal heat from the body forms a subject which is much more complicated, and much more important, than the one we have met to consider, but it is impossible within the limits of our time, to refer to it, except in the measure that is strictly necessary to elucidate the principles that should control the construction of the punkah.

It has often been said that every engineer on his arrival in India sets about improving this useful apparatus, but if we may judge from the endless variety of forms which may be seen in shops and offices, in public and in private buildings, no general principle of construction has been recognised, and the punkah, as we see it, seems to depend, for its form, more upon the taste of the workman who makes it than on anything else.

We shall begin by directing our attention to the suspended punkah, which is usually hung from the ceiling, and put in movement by a cord. The object of this class of punkah is to produce a downward current of air by swinging to and fro, and the best punkah is the one which throws downwards the greatest quantity of air with the smallest applied force.

The swinging punkah is one of the simplest forms of mechanism; it can be fitted up with the most primitive materials, and however badly made it will always have *some* effect. This fact has its good and its bad aspects; it brings a certain comfort within the reach of all, but it removes a great part of that *necessity*, which, as we all know, is the mother of invention.

There are some very important natural laws which are illustrated in the punkah The first is that which governs the movement of the pendulum. The number of swings it makes per minute depends on the length of the suspending cords; a pendulum three feet long will swing $62\frac{1}{2}$ times per minute and a pendulum six feet long will swing $44\frac{1}{4}$ times per minute:—whether the swings are long ones or short ones the number per minute is still the same. You cannot therefore alter the natural rate of movement of a punkah unless you pull it at both sides.

The next law is that which determines that the angles of incidence and of reflection are equal. This in simple language means that it is useless to expect a good downward current of air from a slow moving and heavy punkah, with long suspending cords which keep it nearly always in a vertical position to its plane of movement. Striking the air squarely as it does in its foreward and backward movement, it throws almost as much air upwards as downwards, and of course all the air that is propelled in any other than a downward direction represents just so much power wasted.

One more law and then we may proceed to demonstration.

As the air weighs ·072lbs. per cubic foot at 82° Fahrenheit, and as a considerable quantity of air is put in motion, the power required to drive a punkah depends upon the quantity of air it puts in motion in a given time.

The *useful effect* is a separate matter; it depends on the amount of air thrown in a downward direction.

To summarize: all punkahs of the same size or surface, and going at the same speed, require the same amount of pulling. The best one is that which will throw down more air than any other of the same size.

To obtain the greatest result from the power expended in driving it, the punkah should be placed as near as possible to the person to be cooled, as the loss of effect, due to distance, increases not in direct ratio, but in proportion to the square of the distance between punkah and person. If, at two feet of distance, he receives one-eighth of the total effect, he will at four feet of distance obtain only one-thirty-second part.

In practice the punkah should just clear his head when standing, and the weighting of the curtain should be of some yielding material so as not to damage any person who might stand in its course.

We shall now proceed to examine several forms of punkah, all made to the same size, and, for purposes of comparison, we shall drive them all at the same speed. And in order that their effects may be visible to you, I have prepared an indicator which resembles more than anything else the keyboard of a piano. It consists of a series of balanced levers with blades or keys attached forming a keyboard four feet long. The levers, each three feet long, are delicately hung on fine brass centres, and each lever is counterbalanced by a weight hung in a vessel of water, which acts as a hydraulic break, and checks any spasmodic movement in the apparatus.

On the end of each blade is fixed a disk of white Bristol board four inches in diameter forming a row which faces the audience.

This apparatus is so sensitive that a slight change in the humidity of the atmosphere is sufficient to throw it out of balance.

The power required to drive a punkah is nearly al due to the resistance of the air; that part due to the force of gravity, and the friction of the suspending joints, is scarcely worth counting. We may readily observe the effect of the resistance of the air by swinging two pendulums of equal lengths and having each a large cardboard disk attached. One of the disks shall present its edge to the line of movement and the other its face.

(*Exp.* 1.) They are now swinging, and being both of the same gravity length, they should swing together, and for an equal length of time. This they would do in a vacuum, but you have already observed that one of them is lagging and will evidently soon come to a standstill. It is the one *facing* the air.

If punkahs were pulled from both sides they might be made very much lighter than they are at present, but for the sake of simplicity a single pull is preferred. They must therefore be made of such a weight that they will swing nearly as far on the opposite side as they are pulled on the near side; any greater weight is useless and only serves to wear out the suspending cords, which, by the way, are nearly always too numerous and too thick for their purpose.

(*Exp.* 2.) Here is a panel punkah which we shall try to use without the customary swing bar. It is of calico stretched on a light wooden frame, and you will be able to judge if it swings equally on each side of the post which supports it. The irregularity of its movement shows that it is too light, so we shall add, by way of swing bar, a bar of round iron one and a quarter inch thick.

(*Exp.* 3.) It is now swinging regularly, and experiments have already proved that the swing bar should not be lighter than this one which weighs four-and-a-sixth lbs. per foot of length. Iron is the best material for this purpose, as it offers the smallest surface to the resistance of the air. The length of the suspending cords is usually a matter of accident in the construction of a punkah, but a little attention to the subject will soon convince us that it is one of the most important considerations.

The limit of movement of a punkah is to be found in the man who pulls it. Twenty-four pulls a minute of a length of 36 inches give in practice a speed of 168 linear feet to the punkah curtain. This speed is found to produce a current sufficiently rapid for practical purposes and twenty-four pulls or beats per minute correspond to a length of suspending cord of fifty inches. This length we shall adopt as the standard length for the comparative experiments we are about to make, and a length of nine inches shall be adopted as the distance from the keys of the indicator to the lower edge of the punkah curtain.

(To be continued.)

NOTES FROM HOME.

(From our own Correspondent.)

The development of the material resources of Ireland by means of Public Works was referred by the Government to a Royal Commission, which was constituted in October last. Three main subjects were referred to this Commission, namely:—(1) Deep sea fishing, and the harbours and communications needed for it. (2) Arterial drainage, with special reference to the three great cases of the Shannon in the West, the Barrow in the South, and the Bann in the North. (3) Railways—the management of existing lines, and the provision of extensions. The Commission commenced with the question of arterial drainage, which could be considered in mid-winter better than the Harbours. They have personally inspected the basins of the Shannon, the Barrow and the Bann, besides other districts where important arterial drainage works exist, and have taken a considerable amount of evidence on these special cases and on the general question of arterial drainage. A report is expected from the Commission before Easter on this branch of their inquiries. After the question of arterial drainage the Commission will take into consideration the question of Railways, about which so much interest is felt in Ireland, and thence to that of deep sea fisheries.

Gas has been done away with at Taunton (Somersetshire) where a private firm has entered into a contract to light the town by electricity and oil, commencing the work with the New Year. The progress of electric lighting, however, lags much in England in the march of improvement—caused by the Act of Parliament limiting the period of concession for public lighting to twenty-one years. Other and even more serious restrictions upon the new form of enterprise are those which declare that at the end of this insufficient term of concession the properties can be taken over by corporations or municipal bodies at the then value of the working machinery. Conditions such as these impose an absolute bar to obtaning capital for public lighting by electricity. With an alteration in these terms or an extension of the time of purchase, we should again see electric lighting to the fore, and the companies now languishing in a more flourishing condition with ample work on hand.

Space will only permit me briefly to refer to a paper recently read before the Mining Association and Institute of Cornwall by Mr. J. J. Beringer in which the author proposes a school of mines in Cornwall, combining practical with technical education, the studies going over four years. He recommends a curriculum embracing mathematics and chemistry to be divided as follows:—I. Subjects that may be grouped round mathematics. For the first year, plane and solid geometry. Second year, building construction and theoretical mechanics. For the third year, machine drawing with steam and applied mechanics. II. Subjects grouped with chemistry. For the first year, inorganic chemistry, magnetism and electricity, and in the laboratory elementary analysis. Second year, mineralogy, geology, with advanced analysis. Third year, metallurgy, quantitative analysis. The technology of mining, the raising and dressing of ores, should be taken in the third and fourth years. All the classes should be evening classes and should be worked on the assumption that during the day the student is engaged at his usual occupation. The principal advantage claimed by the author over the existing curriculum was the slow and gradual growth over a forced one as at present. In the discussion which followed the present lack of knowledge among some who conducted mining operations was referred to and several practical speakers spoke in favour of the scheme propounded by the author.

With regard to tramways, a recently published report states that the cable tramway at Highgate seems to work satisfactorily, but although this is the case this particular system does not appear to grow. The same report states that the North London Tramway Company have adopted steam as the motive power on their lines running from Stamford Hill to Ponder's, and and since the opening in April 1885 no serious accident has been reported. In November the line was extended to Finsbury Park. The use of steam seems to have given satisfaction. An Exhibition is to be held in Paris during the coming summer months in celebration of the French Railway Jubilee. The exhibits are to include every conceivable thing in connection with Railways from surveying instruments to locomotives—classified into eight groups in which the arrangement of railway stations, and examples of rolling-stock, the management and equipment of railways, electric signals, brakes, and the general working of the staff, rates of freight, and carriage of produce, tramways and road locomotives find a place. An influential meeting is to be held in London next week, when the chair will be taken by the President of the Institution of Civil Engineers, to hear detailed explanations of the arrangements in contemplation for obtaining the best results from this Exhibition.

At the opening meeting for the year of the Society of Telegraph Engineers and Electricians, held yesterday at the Institution of Civil Engineers, feeling allusions were made to the loss the Society had sustained in the death of Sir Francis Bolton, one of the Vice-Presidents and founders of the Society. Professor Hughes inducted the new President, Sir Charles Bright, into the chair, who delivered his inaugural address. In this the author, after glancing at the rapid progress of the Society, proceeded to review the history of utilization of the telegraph, commencing with its use in connection with Railways, when in 1837 soon after Sir Charles Wheatstone secured his patent, permission was given by the Directors of the London and Birmingham Railway to lay down the wires between Euston Square and Cambden Town Station, which was the first practical realisation of the electric telegraph in its application to Railway working. The President, whose name is so honourably associated with submarine telegraphy, gave an account of his experiments to prove the possibility of sending messages across the Atlantic. He had wires connected up backwards and forwards between London and Manchester so as to form a continuous circuit of a length equal to that of a telegraph cable between Ireland and Newfoundland or more than 2,000 miles, and adopted the method of using a succession of opposite currents which he had previously found to be successful with the magneto-electric instruments he had previously used. By such means in October 1856 he was enabled to send 270 signals per minute through this continuous circuit. Sir Charles then goes on to give interesting particulars of submarine cables which followed on the Atlantic one, both as to their manufacture and their laying. With respect to the latter reference was made to the extreme practical importance of soundings, instancing the oceanic shoals discovered in the laying of the Canaries' cable. Sir Charles then reviewed the taking over of the telegraphs by the Government, refuting the idea that an improvident bargain was made, and concluded his address by a comparison of tariffs and messages for the past thirty years.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, February 12, 1887.

Sirdar Bahadur Bhagut Singh, Executive Engineer, 3rd grade, sub. *pro. tem.*, Rajputana, is transferred to Burma Provincial Establishment.

Public Works Department Notification dated 25th January 1887, transferring Mr. W. Wiseman, Executive Engineer, temporarily from the Establishment under the Director-General of Railways to the Burma Provincial Establishment, is cancelled.

Mr. P. B. Roberts, Executive Engineer, 2nd grade, State Railway, is transferred temporarily to Burma Provincial Establishment.

Military Works Department.

Lieutenant T. F. B. Renny-Tailyour, R.E., Assistant Engineer, 2nd grade, passed the examination for promotion to 1st grade on the 1st January 1887.

Lieutenant T. F. B. Renny-Tailyour, R.E., Assistant Engineer, 2nd grade, passed the colloquial examination in Hindustani on the 3rd January 1887.

Lieutenant E. Townshend, R.E., Assistant Engineer, 1st grade, passed the Departmental Standard Examination on the 23rd January 1887.

Director-General of Railways.

Mr. G. T. St. A. Nixon, Assistant Engineer, 1st grade, is granted by Her Majesty's Secretary of State for India, extraordinary leave without pay for two months in continuation of the leave previously granted to him.

Director-General of Railways' Notification, posting Mr. P. B. Roberts, Executive Engineer, 2nd grade, to the Toungoo-Mandalay Extension of the Burma State Railway, is cancelled.

Mr. W. Wiseman, Executive Engineer, 2nd grade, is, in the interests of the public service, transferred from the Sind-Sagar State Railway to the Toungoo-Mandalay Extension of the Burma State Railway.

Mr. A. Biernacki, class II., Superior Revenue Establishment of State Railways, Locomotive Department, is, on return from furlough, posted to the North-Western Railway.

Burma, February 5, 1887.

Mr. A. H. Broün, Assistant Engineer, 2nd grade, is transferred from the Toungoo to the Pegu division.

Mr. J. C. Wyatt, Executive Engineer, 4th grade, sub. *pro. tem.*, is transferred from Upper to Lower Burma and is posted to the Tharrawaddy division.

From and after the 1st instant the Ningyan Division, Upper Burma circle, Public Works Department, is transferred to the First circle of superintendence, Lower Burma.

N.-W.P. and Oudh, February 12, 1887.

Buildings and Roads Branch.

Mr. A. R. Sutherland, Assistant Engineer, 1st grade, at present attached to the Railway Branch, is granted furlough for 18 months with effect from the 25th March 1887, or subsequent date.

Madras, February 8, 1887.

The services of the undermentioned officer and subordinates are placed temporarily at the disposal of the Government of India for employment in Burma :—

Mr. J. D. Grant, Executive Engineer, 1st grade, sub. *pro. tem.*

Mr. E. Taylor, Supervisor, 1st grade.

Mr. C. N. Joyce, Supervisor, 2nd grade.

The following intimation, received from the Secretary of State, is published :—

Mr. J. M. Span, Executive Engineer, State Railway Surveys Madras, is permitted to return.

Bombay, February 10, 1887.

Rao Bahadur P. P. Chandanam, L.C.E., Executive Engineer, 4th grade, is appointed to act as Executive Engineer, Kanara, during the absence of Captain Lister, R.E., on privilege leave, or until further orders.

Central Provinces, February 12, 1887.

Two months and twelve days' privilege leave, is granted to Mr. J. B. Chirnside, Assistant Engineer, Wardha Coal State Railway, with effect from the 1st current or such subsequent date as he may avail himself of it.

Bengal, February 16, 1887.

Mr. J. C. Mills, Assistant Engineer, 1st grade, Assam-Behar State Railway, passed the Lower Standard Examination in Hindustani on the 3rd January 1887.

Establishment—General.

Mr. J. A. Devenish, Assistant Engineer, attached to the Darjeeling Division, passed the examination in Hindustani by the Lower Standard on the 5th July 1886.

Establishment—Irrigation.

The services of Mr. J. H. Apjohn, Executive Engineer, 1st grade are placed at the disposal of the Commissioners for making improvements in the Port of Calcutta, for employment as Superintending Engineer on the new Docks and other Port Trust works, during the absence, on furlough, of Mr. W. Duff Bruce, Vice-Chairman of the Port Commissioners, or until further orders.

Mr. A. Hayes, Executive Engineer, is transferred from the Orissa to the South-Western Circle, and appointed to hold charge of the Balasore Division, *vice* Mr. J. H. Apjohn, Executive Engineer, lent to the Calcutta Port Trust.

Mr. J. T. Bosse, Executive Engineer, 4rth grade, temporary rank, attached to the Buxar Division, is transferred from the Sone to the Orissa Circle, and appointed to hold charge of the Aquapada-Jajepore Division, *vice* Mr. A. Hayes, transferred to the South-Western Circle.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

February 10, 1887.

125 of 1886.—James Thorne Roe, of 3, Earlsfield Villas, Balham Park Road, in the County of Surrey, England, Engineer.—*For improvements in apparatus for connecting together or coupling and uncoupling Railway wagons and other vehicles.*

168 of 1886.—Charles Potter, Agent, of 47, Greek Street, Stockport, in the County of Cheshire, Kingdom of Great Britain.—*For improvements in the method of and means for ventilating hats, helmets or other similar head coverings.*

190 of 1886.—Louis Bollmann, Engineer, of Vienna, in the Empire of Austria.—*For improvements in the method of and machines for sewing bags, sails and the like.*

193 of 1886.—Richard Welsted Day, of 103, Patrick's Street, in the City of Cork and United Kingdom of Great Britian and Ireland, Saddler and Harness-maker.—*For improvements in carriage and gig and other harness.*

22 of 1887.—William Jackson, Engineer, of Thorn Grove, Aberdeen, Scotland.—*For improvements in machinery for rolling tea leaves.*

SELECTED ABSTRACTS OF RECENT INDIAN SPECIFICATIONS.

A construction of Lock Nut.—11 (1887).—*Samuel De la Grange Williams.* Relates to a construction of nuts for screw bolts, in such a manner that, when they are screwed upon their bolts they are not liable to become loosened or unscrewed by vibration. This invention is applicable not only to new nuts as they are made, but also to old nuts, even after they have been in use. For this purpose, the nut is tapped with a thread suitable in diameter, form, size, and pitch to the bolt which it has to fit, and then preferably near that end of the nut which is to be the outer end when it is screwed on the bolt, pressure is applied to the sides of the nut or a moderate blow such as will force the metal slightly inwards. This may be applied only to two opposite sides, or it may be applied to the four sides of a square nut or to the six sides of a hexagonal nut, or to two or three of those sides. The effect of this lateral squeezing of the metal is slightly to deform the circular hole of the nut, flattening parts of it, so that when the bolt, which freely enters the nut and screws freely along part of its depth, reaches the slightly deformed part of its hole it becomes tightly gripped by that part of the nut, and the nut when it is screwed home, has so firm a hold of the bolt that it is not liable to become loosened or unscrewed by vibration.

Method of and Apparatus for Lighting Railway Trains or Tramways by Gas. 109 (1886). *William Bennet Rickman.* The gas is produced by distinctive distillation of paraffin oil in retorts. It is cleared of its tar and impurities, collected in a gasometer and compressed by pumping into a reservoir where it is retained under considerable pressure, such as that of 10 atmospheres, until it is required for use. Each carriage of the train that is to be lighted is provided with a small reservoir, which is charged up to a pressure of about 6 atmospheres by connecting it by a flexible tube to a main leading from the reservoir of compressed gas. This charging is effected from time to time, usually twice or thrice weekly, while the train rests in the neighbourhood of the gas-works. In cases where it is inconvenient to charge a train near the gas-works, reservoirs mounted on trucks are charged from the main reservoir at the gas-works, and these reservoir trucks are sent along the Railway line to places convenient for charging the trains. From the reservoir on each carriage a pipe conducts the compressed gas, first through a regulator, which becomes reduced notwithstanding the variation of pressure in the reservoir, as its charge determines a constant moderate pressure suitable for combustion, equivalent to about half an inch column of water. From the regulator the gas is led by branch pipes to the burners in the several compartments of the carriage.

When it is desired to give a guard or official on the train power of controlling the light so that they may burn fully,—when for instance the train passes through a tunnel, or may be reduced when there is sufficient daylight,—a pneumatic diaphragm valve is provided in the gas supply pipe on each carriage, and all the diaphragm chambers of these valves are connected throughout the train by an air-pipe, the pressure in which can be varied by the guard or official who thus works simultaneously the valves throughout the train, thereby increasing or lessening the light as may be desired.

Notices.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Answers to Correspondents.

SEVERAL Contributions are unavoidably held over, but we have increased our space, as a temporary measure, to dispose of arrears.

INDIAN ENGINEERING.

SATURDAY, FEBRUARY 26, 1887.

THE PUBLIC SERVICE COMMISSION.

II.

THE general problem of administration—how to derive the greatest possible benefit from the actual talents of the country has no where satisfactorily been solved. A mathematician, in stating a problem, might be careful that all the data of the question are introduced into his equations. Sometimes, however, the complexity of the problem is such that he forms partial equations of discovery, by treating certain elements as constant which he knows do really vary—or it may be he finds it useful to omit some elements altogether.

In this partial sort of way all countries have hitherto proceeded in developing their constitutions. The fact is that good government is an extremely difficult matter; and just as we cannot expect a Newton or a Darwin even once in every century so statesmen of commanding ability are equally rarely produced. In science, however, when a Newton or a Darwin has once pointed out the way, men of much inferior capacity can follow the paths they trod. And any subjects in which the principles have been properly laid down by the few and in which the details are being worked out by the many is entitled to be called a science.

If the noblest study of mankind is man it does appear desirable that capable minds should devote increased attention to the science of good government. From the time of Thucydides downwards—and indeed from a much older date—there have not been wanting men who have studied the laws which govern the growth of communities; and who have seen that in these laws—rather than in the caprices—be they evil or be they good—of individual despots—are laid the true lines of history. But only in times more recent—after the discovery of the art of printing and the growth of the modern press—has the problem been definitely formulated and ever persistently attacked. The writings of such men as Herbert Spencer or John Stuart Mill in England with the corresponding writings of French and German thinkers—these are the true and immediate causes of the political movements of to-day.

The scientific student of the structure of civilisation sees everywhere two conflicting human instincts—the conservative and the progressive. Neither of these is a sufficient expression of the whole art of construction. The progressive instinct brings bricks to the building, but the conservative instinct supplies the mortar that binds the bricks together. At one time in the history of a people the progressive instinct is most in evidence. But to this time of superabundant activity must follow a period of apparent or comparative repose. Consolidating influences then begin to do their silent work.

On one of these epochs of consolidation India has now entered. The problems of administration in India are varied and highly complex. We cannot, like an English judge, look back for a supply of precedents, for the work

which the English have in hand in India is without a counterpart in history.

In controlling the rate at which changes in India shall advance the great difficulty of a capable Indian administrator is to keep the Home Government or the English democracy from unduly forcing the pace. Immediately below the falls of Niagara the great mass of water grows calm. It moves so slowly that small boats are constantly crossing over. But lower down where the stream is somewhat diminished in breadth and is notably diminished in depth, it breaks into a gallop like a troop of wild horses,—tossing their snow-white manes. And such at times may be the pace through which changes are hurrying in England. But in this far East the changes should continue to keep their quiet flow—little disturbed by what is happening in the energetic and tumultuous West.

THE EMPLOYMENT OF NATIVES AS GEOLOGISTS.

MR. MEDLICOTT, Director of the Geological Survey of India, has devoted a few paragraphs in his annual report for 1886 on the employment of natives as geologists. Without endorsing his views in their entirety, we will reproduce his arguments, with such remarks as we think might tend to elucidate the subject and help the public to arrive at a satisfactory solution of the difficulty, which has, on his own admission, exercised his department for the last fifteen years. While accepting the principle of the general question of the employment of the subject races by Government, Mr. Medlicott would like to see it limited by reason. Considering that "the Geological Department is a mere drop in the ocean of the services," he sees no urgency for such employment. He adduces special reasons against admitting natives in his department, and starts with the assertion that "the survey has no duties of a mechanical nature, to which and through which it would be possible to break in the uninitiated; that the facts it has to deal with are not facts in the meaning as immediately appreciable to the senses." So far we are at one with Mr. Medlicott, but when he says that "an engineer may do fair work with little or no knowledge of mechanics" he takes up a position which seems to us to be untenable. No engineer worthy of the name can lay the slightest pretension to be termed professional who has not acquired a sound knowledge of statics and dynamics. Practical rules are all well in their own way, but they fail in their application in a great many instances where the operator comes face to face with facts which are beyond the pale of those rules. No man can claim originality in any technical pursuit, whose education has not been based on the elementary principles of science. Mr. Medlicott's arguments when divested of superfluities, lie in a nutshell. He lays down the following law: In geology "there is no operation called for; every act in its service is an independent judgment upon very complex inductive facts through an accurate knowledge of physical phenomena and their laws; if not scientific it is nonsense. Further it is to be noted that the data upon which the geologist has to frame his judgments are for the most part very scanty: from occasional scattered sections or single outcrops he has to attempt the representation of the rocks as they lie underground and of their remote history. Thus, though based on the exact, it is itself the most inexact of sciences, and eminently demands conscientious and sober judgment." In other words, the "inductive faculty" comes oftener and more prominently into play than any other mental operation, and this the writer thinks is what the natives of India, and of Bengal in particular, lack most. To prove his theory he institutes a comparision between the chiefs in the annals of science in Europe and the natives of this country, and arrives at the conclusion that whereas the majority of the former, in whom the mental form is alive, have been self-taught men, in Bengal, after 50 years of education, there is not found a single individual who has shown a capacity for original scientific work. In fact, so much time, labour and money have been thrown away upon the Bengali. These are hard and sweeping remarks, the truth of which we are reluctantly compelled to believe—in part—at least—for the present.

BELGIAN RIVALRY IN CHINA.

WE learn from a Continental paper that Belgium is now trying her hand at coaxing the Celestials into the belief, that the introduction of a net work of railways would convert the "Flowery Land" into a veritable paradise on earth. With this object in view Baron Sadoine, late business manager of the well-known Cockerill Works of Seraing, has left for China. Just before his departure the traditional formalities of European civilization were scrupulously observed. He was *fêted*, banquetted in due course, and the speeches made on the occasion all anticipated success; the King of the Belgians, too, did not forget to accord him his good wishes. So the Baron has embarked under favourable auspices. To invest the undertaking with a business-like aspect, he will associate with himself, as his *compagnon de voyage* during his tour in the interior, an "influential personage," who seems to be an indispensable adjunct in a venture of this kind. The fact, however, remains that we have so often heard of unrealized schemes in connection with the opening up of China to European enterprise, our belief in it is a little bit shaken, and we feel justified in not committing ourselves to a definite opinion, until such time at least as the prospect of their realization appears a little more cheering. To confess the truth we are not at all sanguine in regard to the consummation of these fondly cherished desires. Three of the Great Powers of Europe, England, Germany and France, who enjoy the friendship of the Emperor of China, have, one by one, exhausted all their arts of statesmanship to induce the Emperor to adopt railways as a certain means of improving the internal communications in his country. He has invariably lent a deaf ear to the charmer, charm he ever so wisely. Whether from a spirit of conservatism, or national jealousy, or from whatever cause, the suggestions have always met with disfavour at the Court of Pekin. The Chinese have long been wedded to their thorough exclusiveness to accept a change at the persuasion of "strangers," which might revolutionise, in the not distant future, their

ancient manners and customs, by the introduction of foreign arts and manufactures in their midst. Face to face with such discouraging results, it is apparent that the Baron has strong faith in himself or in his mission to convert the Heathen Chinee. But the knowing ones say that he means to bring down two birds with one stone, and although the ostensible object of his visit is what we have stated above, it is quite likely he will be "canvassing" on account of the firm he represents, in which case his efforts might be crowned with partial success.

GOODS-WAGGONS' COUPLINGS.

One of the most important questions of the day as regards railway plant is that of goods-waggons' couplings. In securing together the different sections of trains, and in detaching them one from another, a large proportion of the accidents to railway servants which are annually reported by the Board of Trade have always occurred. These accidents arise mainly from the necessity of getting between the waggons to couple or uncouple by hand. In doing this the operator is liable to slip, and then, if the waggons are in motion, he may get jammed between the buffers, or be run over on the rail. In America, where a system of central buffers and self-acting draw-hooks is in vogue, these accidents cannot well occur, for, in the first place, there is no need for any manual operation to couple the vehicles; and, in the second place, if there were, there is free access to them; side buffers being altogether absent. On the British railway systems, however, chain couplings in duplicate, with central spring draw-hooks, and side spring buffers are now almost universal. To do away with these, and adapt in their stead a central spring buffer as well as coupling, would involve such a radical change in the rolling-stock of the country and such an enormous extra expenditure, that it may be put down as impracticable; and the only course remaining is to endeavour to devise a method of coupling and uncoupling which shall utilize existing appliances whilst doing away with undue risks to life and limb.

Sometime since an exhibition of appliances for getting over the difficulties which have been described was held at Nine Elms goods station on the London and South-Western Railway. Several inventions were exhibited, most of them consisting of systems of levers attached to trucks at each end, and each side, in such a way that an attendant can couple or uncouple without going within the buffers. The exhibition was under the auspices of the "Amalgamated Society of Railway-servants." Three money prizes were given for the best automatic, and three others for the best non-automatic couplings. The Midland Railway Co. responded to the invitation to test practically, the prize systems by offering to have a pair of trucks belonging to their railway fitted with each of the systems which had gained prizes. Five of the patentees accepted this offer, and the requisite alterations were made by the 2nd December last year (1886), when the Directors and a number of other gentlemen interested in the matter assembled at Derby to witness experiments, and, if possible, to come to some conclusion. On a branch line near the experimental trucks was a train of waggons fitted with ordinary couplings as customary on the Midland Railway. Standing near them were some men accustomed to shunting work, and each one was furnished with an ashen pole ending in a steel point to which a spiral twist was given, like half a turn of a cork-screw. By means of this instrument inserted between the trucks, either over or under the buffers, the men could with the greatest ease either couple or uncouple the waggons. So expert were they, that one of them ran along the whole train, consisting of 23 waggons, and uncoupled them at the rate of three seconds per waggon; and another coupled them all up again at the rate of four seconds per waggon. In doing this, each of the men carried a lamp to prove that the same thing could be done equally well by night. Some of the gentlemen present tried what they could do; and found that with two or three minutes' practice they could use the steel pointed pole almost as effectually as the shunters themselves.

A very careful inspection was made by those present of the five systems from the Nine Elms exhibition which had been fitted to Midland waggons. These were all ingenious, and all more or less efficacious. That is to say, by means of all of them waggons could be coupled or uncoupled from outside the buffers, and without the necessity of going between the rails. This was, however, strictly speaking, only true when the waggons were upon a straight part of the line. When they were tried upon a curve most of the novel systems failed for want of more side play in the apparatus. This is a point which, however, might have been remedied. Most of the systems consisted of levers jointed by pins and fastened with bolts, nuts, etc. All this would entail a substantial extra cost amounting to some pounds per waggon over and above the couplings themselves. It would also entail dangers of sticking joints, damage by bending, breakage, and loss of parts. Additional complication is obviously objectionable, and any railway company would be justified in refusing to take any steps at present differing from their ordinary practice on this ground alone. But the unanimous verdict of those present was, that the system, which has been described as at present in use on the Midland Railway, is simpler, cheaper, more effective than any of the Nine Elms systems. In fact, there was not one of them that came near it. Involving as it does nothing but a simple implement, worth but a few shillings at most, external and unattached to the trucks in any way, capable of being used from either side of the waggons, and introduced above or below the buffers, according to the pleasure of the operator, it is really the simplest plan imaginable. It can be learned in two or three minutes, and should the instrument break it can be thrown aside, and be replaced by another, without any appreciable loss of time. Considering that the judgment, which was freely and almost unanimously expressed, as to the superiority of the pointed pole system over all the others came from a body of competent and disinterested Engineers, it may be taken for granted that the coupling question has now been set at rest for a long time to come.

Notes and Comments.

SIR BRADFORD LESLIE ON INDIAN ENGINEERING.—All the science and experience in the world are no good without an energetic and willing executive staff, and in this climate a good stock of European pluck and stamina to endure hard work and exposure is indispensable.

VICTORIA TERMINUS, G. I. P. R.—The extensive terminal buildings of the Great Indian Peninsular Railway at Bombay, of which Mr. F. W. Stevens, C.E., is the architect and engineer, have been named the "Victoria Terminus" in commemoration of H. M. the Queen Empress' Jubilee.

PUBLIC WORKS IN BURMAH.—We learn that after paying for establishments, and the necessary repairs of existing roads, canals, buildings and embankments, there will be only about 3¼ lakhs left for new works in Lower Burmah next official year. The principal new works for which provision has been made out of this very meagre allotment are :—The Abya escape weir on the Pegu Canal ; The Kyaikto Canal ; The Protection of the Alguada lighthouse ; The Pegu river bridge in the town of Pegu ; Certain roads on the Thayetmyo frontier.

P. W. D. ADMINISTRATION—COORG, 1885-86.—The Chief Commissioner reports that the budget allotment for public works was exceeded by Rs. 7,817. The work connected with the building of the bridge over the river Cauvery at Siddapur was nearly completed at the close of the year. All the old roads are said to have been raised to standard and maintained in trafficable order throughout the year. On the whole, considering the difficulties, the work done by the Public Works Department during the year is not unsatisfactory, but the public have complained with some reason of the state of some of the roads and bridges.

CALCUTTA JUBILEE ILLUMINATIONS.—We endorse the view of a local paper that perhaps no such display on an equal scale was ever arranged for on such short notice as the recent display at Calcutta. Only those who were, so to speak, behind the scenes have any idea of the amount of work involved in the preparations, and it is safe to say that, in regard to the larger buildings, had some regular system not been adopted, it would have been quite impossible to have overtaken the work at all. To the Public Works Department the greatest credit is due for the manner in which it acquitted itself of a task lying so far out of the range of its ordinary duties.

"CEYLON RAILWAYS."—Further delay will, it is said, take place at the Blackwater Slip. It was hoped that goods trains would run through by the 1st of February, but we learn on good authority that this will not be possible, as trains could not pass through without danger until the whole mass which slipped has been removed: but though a good deal of earth has been taken off and a wide embankment on which to lay the rails formed yet there is a vast amount of treacherous rock and slime to be got rid of, and this will take a couple of months more. All this of course means a heavy burden on the Railway which it can ill afford to bear at the present time.

WEAR AND TEAR OF RAILS.—We are informed that the 42lbs. steel rails on the South Indian metre gauge line are so badly worn as to need very extensive renewals, and are to be replaced by rails of 50lbs. The 42lbs. rails are only 10 years old. On the other hand, there has been practically no wear in the 75lbs. steel rails used on the Madras broad gauge line, although some of them are 15 and 20 years old. In connection with this subject we may observe that *speed* must be an element in the wear of rails when it exceeds say 15 miles an hour ; but it is a mistake to suppose that a line with steep gradients can be worked as economically in this respect as a level one.

THE ADELAIDE JUBILEE EXHIBITION, 1887.—We would call attention to the International Exhibition to be held at Adelaide this year. This Exhibition is not held primarily in honour of Her Majesty's Jubilee, but to commemorate the attainment, on 28th December 1886, of the fiftieth year of the existence of the Colony of South Australia As the age of the Colony happens however to be coeval with Her Majesty's reign, advantage has been taken of that circumstance to fix the day for the opening of the Exhibition for the 20th June 1887, the date of the completion of the fiftieth year of Her Majesty's reign. The Exhibition, which will remain open for about six months, is under the most distinguished auspices.

THE PROMOTION OF INDIGENOUS ART.—Major H. H. Cole, R.E., submits that native architects must know their ancient art before they can revive it, and that it is as varied in feature and detail as the Western types. Sir Lepel Griffin doubts whether a native designer competent to put intelligently on paper an artistic, beautiful, and appropriate design for an important building could be found, and adds that plans and estimates, however unpicturesque they may be, are a condition of economical and honest work, which a native designer is rarely able to furnish satisfactorily. The old palaces which we so much admire were built, in great part, by forced or underpaid labour and were monuments of waste and corruption.

ENGLISH *v.* INDIAN PURCHASES.—A correspondent writes :—I am glad to see you have taken up the ridiculous orders in the P. W. D. about purchase of English stores by Executives in this country (see Appendix O., P. W. Code, vol. I., 5th edn). The purchase of a trifling quantity of window glass, iron, cement or a hundred other little articles daily required, involves no end of correspondence for sanction. Practically the rules cannot be observed except by laying in large stocks to meet requirements as they arise, on which great loss would sure to result. Hence time, paper and labor is wasted to get sanction for every trifling purchase that is to be made ; besides centring supply in the India Office Store Department is, I consider, objectionable, and I hope to see this matter strongly dealt with in INDIAN ENGINREERING.

PROGRESS IN CEYLON during 1886.—The Telegraph Department has been extending its usefulness and doing good steady work. The Telephone has not been a brilliant success, nor have experiments in Electric Light succeeded, although it is anticipated that ere long much may be done in this direction. Meantime Gas scarcely pays its way in Colombo ; and as for the Waterworks, begun in 1882, they are likely to be the hugest blot on the Administration during Sir Arthur Gordon's time : time and money have been largely spent in excess of estimates ; but of the results no one can be proud. Electricity as a motor has attracted much attention and it is likely to be applied freely in the Central Province. The Railway Department has not been in the best repute through "slips" and inconvenient "service" ; and although reduced rates at the beginning of the year gave satisfaction, still public opinion is generally unfavourable.

SINGAPORE DOCKS.—The New Harbour Dock Company has extensive wharf and warehouse accommodation, with every convenience for discharging and coaling of steamers. Its docking convenience consists of two graving docks, one 459 feet long by 62 feet wide with 20 feet depth of water, the other 415 long, 42 feet wide with 15 feet depth of water. There are also machine shops and foundries provided with every appliance for the speedy and efficient repair of vessels. The Tanjong Pagar Dock Co. has also two graving docks; one 450 feet in length by 65 feet wide with a depth of 20 feet of water. The other is 475 in length, 60 feet wide with 21 feet depth of water. Both are fitted with pumping gear that empties them in three hours. For executing repairs, there are extensive machine shops and mechanical engineer works, with all the necessary tools and appliances for effecting extensive repairs. The wharves of this company are over one and a quarter mile in length.

SIND-PESHIN RAILWAY.—It is reported that two months will see the completion of the Sind-Peshin Railway. One of the two great obstacles delaying this desirable end has been successfully overcome and the Jubilee day will see the first engine over the 'Chupper rift' bridge. The central span has been the difficulty on this bridge and is only 150ft., but being across a chasm 250ft. deep no staging could be erected from below. The difficulty has been overcome by using two pairs of 150 girders belonging to a bridge further on as cantilevers and constructing the permanent girders on them—the former acting as staging. The next obstacle is the 'mud gorge.' Here the line runs along the side of a mud hill, which slips sometimes above the line and sometimes below it and thus either fills up the work previously done or carries it bodily down the slope. It is hoped, however, that the natural slope will be reached in the time named and Government may then be congratulated on the completion of a strategical railway.

BOMBAY GREAT MUNICIPAL WORK.—The main features of the *Tansa* Water-supply Project now in progress are summed as follows:—A dam will be constructed across the Tansa river at a point behind the Mahuli hills, 53½ miles distant from Bombay. The height of the dam will be at first 109 and subsequently 133 feet above the bed of the river. The area of the proposed lake will be eight square miles. The catchment area, the yearly rainfall in which exceeds 100 inches, will be 52 square miles. The available daily water-supply throughout the dry season will be 100 million gallons. The water will be brought into Bombay by tunnels, conduits and pipes which will be capable of delivering a supply of 33 million gallons daily in the city. This supply added to the existing supply from the Tulsi and Vehar lakes, will be more than ample after making every allowance for the growth of the population of a city that increases in size and importance year by year. The capital expenditure will be 123 lakhs of rupees which will be distributed over a period of seven years, the time required before the works will be completed.

THE VICEROY'S RECENT TRIBUTE TO THE PROFESSION.—Only those who are experts in these matters can have an adequate conception of the labour, the anxiety, and the wearing sense of responsibility which taxes the nerve and brain of those to whom is entrusted the task of bridling and bridging our mighty rivers. To the casual spectator who sees the finished structure springing so airily from bank to bank, with its wide-spaced piers and trim and slender arches, and the acquiescent river slipping away so complacently below it, its successful completion may appear a matter of every-day occurrence. But if we ponder for a moment on the nature of the forces concerned, the power and mass of the water to be dealt with, the enormous weights of iron to be handled, the delicate adjustments to be calculated, and the distances to be spanned, we may well wonder how human beings, who would find it difficult to raise a hundred pounds a foot from the ground, should have succeeded, by the sheer dint of ingenuity and intellect, in producing such stupendous results as those which are being daily wrought by our great Engineers.

INDIAN *v.* RUSSIAN LINSEED-OIL.—It having been suggested that the amount paid for the considerable quantity of linseed-oil imported into Southern India might be saved if the quantity of the Indian oil could be assimilated to that of the imported article. Samples of the oil produced in the Madras Presidency were sent to the Chemical Examiner with a request that he would state what was the cause of the richer quality of the Indian oil as compared with that produced in Russia, and how the Indian oil could be assimilated in quality to the Russian article so as to make it equally useful for painter's work, and for the manufacture of floor cloth. The reply elicited shows, that the drying qualities of the Indian and imported oils in their raw state are nearly similar, the slight difference being in favor of the imported article, and that on boiling a sample of the Indian oil with litharge and another with rosin and litharge and comparing them with the imported oil treated in the same manner no perceptible difference in their drying qualities could be seen. It is believed that the climate and the character of the seed used would probably account for why the Indian oil is richer and the Russian oil is superior in drying qualities.

"CLOUDS IN THE MADRAS HARBOUR."—It would appear from the Proceedings of the Madras Harbour Board that the complication between the Trustees and Mr. Thorowgood first arose from the Chairman of the Board requesting the favour of the opinion of the Superintendent of Works, in reference to a note by Mr. Guilford L. Molesworth, C.E., upon the proposed north-east entrance to the Harbour, and sundry points in connection therewith suggested by Captain Baddeley, R.E. In reply thereto, the Superintendent of Works regretted that he was not prepared just then to submit anything in the way of an alteration to the design of the Harbour, and saying that he awaited the instructions of the authorities at the India Office to whom the question had been referred. To this the Chairman of the Harbour Trust demurred, stating that the Board did not desire any reference being made to the India Office, as such action would be premature, but merely wished to be put in possession of the Superintendent's views, based on local experience, and that the reference should be withdrawn so far as being at the instance of the Board. The Superintendent, while regretting that the reference had been made, explained that he had not the least intention of referring to the India Office, having only telegraphed to Mr. Parkes, who in reply said that the question had been referred to the India Office, the point referred being as to whether the Superintendent was at liberty to carry out the Board's orders in this respect. The Board thereon recorded its regret that Mr. Thorowgood should have considered it necessary to refer by telegraph to Mr. Parkes without first communicating with the Chairman.

Current News.

On Wednesday last His Excellency the Viceroy formally opened the "Jubilee Bridge" at Hooghly, Sir Rivers Thompson and Sir Bradford Leslie also taking part in the ceremony. The running of the East Indian mail trains over the bridge will probably begin on the 1st proximo. The regular goods traffic will not begin till the 15th. The Engineer and all concerned are to be congratulated on the eminently successful completion of this important undertaking.

Sir Theodore Hope's term of office will expire on 22nd July.

The Bengal-Nagpore Railway, with a capital of three millions, will be launched by Rothschilds.

Captain H. D. Love, Principal of the College of Engineering, Madras, has obtained furlough to Europe for twenty months from or after the 19th March 1887.

Mr. W. R. Robertson, Principal of the College of Agriculture, Madras, goes on furlough to Europe for one year and six months from or after 1st April 1887.

The Government of India has agreed to a system of ten years contracts with the six Indian Brewery Companies, in place of the ordinary terms of from three to five years.

The preliminary survey for a proposed steam tramway on the old Benares road form Sealkala to Howrah passing through Jonai, a total distance of about 21 miles, has just been completed by Mr. P. B. LePatourel for Messrs. Mitchell & Co.

The authorities contemplate constructing a narrow-gauge tramway on the Ruby Mines Road, Upper Burmah, as a means of utilising some 20 miles of 2½ feet gauge rails, with gear and rolling stock, fit for immediate erection and available.

The Punjab Government have given orders for the preparation of a survey for a line of railway between Puttiala and Batinda, and Mr. W. Macdonald, Executive Engineer, has been deputed to start operations at once. The ground is described as being peculiarly favourable for such a work, there being absolutely no rivers or streams of any magnitude in the entire length of one hundred miles.

A Rangoon correspondent suggests an evidently desirable improvement in the water communications of Burmah. The channel of the Irrawaddy is notoriously tortuous and difficult, with sprinkled rocks and sandbanks; and now, when the water is low and the country well supplied with Sappers and Engineer officers, should be an admirable opportunity for remedying this state of things once for all.

Proposals are now under consideration for the lighting of railway trains in India by electricity, the Secretary of State and the authorities in this country having both interested themselves in the mat er. Experiments are likely to be shortly carried out, and we hope they will prove successful, for all travellers know what weary hours have to be passed after sunset when long journeys by rail are being made.

The scheme for the supply of drinking water to the city of Peshawur from the Bara River is still under the consideration of the Municipal Committee; some difficulty being experienced in finding the money for the project, which is estimated to cost something over three lakhs of rupees. A suggestion has been made that the funds shall be provided in four instalments, between the months of April 1887 and October 1888.

One of the mot notable celebrations of the Jubilee was that in Pishin, where the ceremony consisted in sending an engine for the first time over the four miles of tunnels and viaducts that take the railway through the Chuppar rift, and over the Chuppar bridge, a work 600 feet long and 300 high. Thus the day was marked by the final triumph over the greatest obstacle that has been encountered by the Sind-Pishin Railway. Captain B. Scott, R.E., was the engineer in charge.

A further endeavour is to be made to discover whether petroleum cannot be found in paying quantities in the Rawal Pindi district. Boring operations are to be resumed, and carried down to a depth of not less than 500 feet in each case; some Rs. 6,000 having been sanctioned by the Government of India, in the Military Works Department, for the purpose. Mr. Townsend has returned to India, and has brought back with him the most approved apparatus from America to resume the experimental borings in the Biluchistan Agency.

The reorganization of the Punjab Railway system has been practically decided on. The line now known as the North-Western Railway will be divided into two sections, the junction being at Mozufferabad, or virtually at Multan. Each section will be under the control of a Manager: Mr. Jabez Lightfoot being appointed Manager of the Punjab Section, and Major Brackenbury, R.E., Manager of the Sindh Section. Colonel Conway Gordon, C.I.E., R.E., whose powers are thus largely enhanced, will be "Director of the North-Western Railway system."

The frontier railways and cross road communications along the Punjab border continue to be pressed on with vigour. The Sindh-Sagur cross railway line, connecting the Derajat with the trunk North-West line, has been pushed on with energy; and the sections of the line from the west bank of the Chenab near Moozuffergurh, and from the west bank of the Jhelum near Chuk Nizam, were recently linked together—and the line thrown open to public traffic. This completes the entire Sindh-Sagur line, with the exception of the bridge across the Jhelum at Chuk Nizam, which is still under construction. The bridge over the Chenab at Ramoowallah, opposite Moozuffergurh, is also a work of the future, but the passage of the Chenab at this point, can be rapidly effected by steamers.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

PROVINCIAL PUBLIC WORKS, N.-W. P. AND OUDH.

Sir,—I was glad to notice your review of the Administration and Progress Report of the P. W. D. of the N.-W. P. and Oudh for the year 1885-86. It seems to me that a few points still require noticing, and that comment on them may lead to beneficial action on the part of the Local Government. I will just mention *en passant* that I fully and cordially concur in what you have said in the three concluding paragraphs of your criticism.

2. With regard to the new scheme which was inaugurated on the 1st January I have nothing further to remark. I merely reiterate my opinion given in paragraph 4 of my letter published in your No. 4, Vol. I.

3. I must say that the Roorkee workshop is a thorn in the side of Government. I am of opinion that Messrs. Richardson and Cruddas of Bombay, would readily purchase it, if the Government would give them a guarantee that all manufactured iron work required for Government purposes would be purchased from their new manufactory at Roorkee. There is no reason why that firm could not manufacture even railway bridges for the Government; I mean bridges such as we see in scores, over the numerous small streams in all parts of India. They have the *material*. All that they want is a *few practical English foremen "au fait" with iron construction*. The engineering part of the business could be easily done by the leading representatives of the firm in India.

4. The Muir College is certainly a success, I mean that part of it which reveals to the eye of the observer, a structure second only to the Taj mahal. Scanty notice has been taken of the exertions of Mr. Heinig, and I think that I am right in saying that honours are given to other Civil Servants of Government for the achievement of very much less than what Mr. Heinig has *obtained for Government*. Of course we all know that Mr Heinig was doing his duty, but then the Victoria Cross and other minor honours such as K. C. S. I. and C. I. E. are given for the successful performance of duty, and I do think, that, if Mr. Heinig is too bashful to accept a C. I. E., the Government should recognise his services in a *substantial manner*. But, perhaps, under present financial difficulties this would be *inadmissible*. Under these circumstances would a Superintending Engineeership be *too much*? I am sure many of us would hail with satisfaction Mr. Heinig's advent as Superintending Engineer into one of *our coveted Circles in these Provinces*.

5. With regard to the Roorkee Civil Engineering College, I think that a radical change is necessary. Nearly two lakhs of rupees per annum are devoted towards the maintenance of that important institution, and charged to our Provincial Budget allotments But why in all conscience keep on in the same groove for generations! Why does not the Local Government take a "bold departure" and re-establish or rather re-organise the College, making it a National College! Make, I say, the Roorkee Thomason College, the only monument to one of our popular and *far-seeing* Governors, a *National Institution*, and compel each province of India to contribute Rs. 50,000 for its support. This administrative reform would, I am sure, prove a *very* great success, and our burden would be lightened to the tune of a lakh of rupees. The College once organised on this basis would develop into the Engineering *alma mater* of our Empire in he East. But, dear Mr. Editor, if I strain my abilities further to be eloquent, I fear I may be lead away and get out of my depth; will therefore say adieu, and close this tirade.—No! I can hardly presume to call it by that name,—let it be a *wail* to the "powers that be" to "wake up and be doing."

R.

COMPARATIVE OUTTURN FROM SUGAR-CANE.

Sir,—My attention has been drawn to a letter signed "N. J. B." in your issue of the 19th instant, regarding the comparative outturn of sugar from cane in India.

It is a little difficult to form a correct estimate of sugar outturn from your correspondent's letter. He says that in some of his trials with cane grown in India, "which is far inferior to cane grown in Louisiana," he got 170lbs. sugar from one ton of cane. He does not say what *quality* of sugar he got, whether pure white crystals or 'first' sugar. If the former, then the quantity he got was much in excess of anything obtained in Louisiana, even by the new diffusion process. At a discussion of the United States sugar trade on 9th December 1886, Mr. G. B. Loring, Executive Commissioner of Agriculture, said that Professor Wiley with the diffusion battery obtained 144lbs. of fine sugar per ton from Louisiana cane, which, he said, was "fully 30 per cent. more than has ever been obtained by the best milling on similar cane in Louisiana." If, therefore, "N. J. B." has not made a mistake, the inference is that he has succeeded in getting 27lbs. of fine sugar per ton from Indian cane more than can be obtained from the best Louisiana cane by the diffusion process.

Canes contain from 7 to 16 per cent. of sugar, according to quality, which is very much dependent upon variety, soil, climate and other conditions ; while the highest percentage extracted has reached 10·40, and this from the best Cuban cane. I cannot help thinking that your correspondent has over-estimated the outturn of sugar per ton of Indian cane. If he will be more explicit, perhaps I may be able to give him further information.

21st February 1887. POWNDA.

BENGAL-NAGPORE RAILWAY.

I AM greatly surprised at the decision arrived at by the Supreme Government in regard to the location of the junction of this Railway at Sitarampore instead of at Asansol. The reason assigned is that the various coal companies having thought better have reduced their claims to reasonable limits, and as, I suppose, the present law does not enforce the acquisition of both rights, which would involve a large outlay at the onset, the Government had no alternative but the choice made. It appears to me that there is nothing to prevent the various coal proprietories from driving their workings under the proposed line, and thus compel Government to pay for the coal thereunder. But I can hardly believe that the authorities were so wanting in foresight as to have missed this important point. I am informed that the alternative—Asansol—route shewed a better and more economical road than the original one from Sitarampore. Along the Asansol route coal does not exist, and not only do the physical aspects of the country favor this alignment, but the fact of a saving in the running distance of 7 miles per train trip! This latter circumstance which, of itself is an important factor of economy, coupled with the strong recommendation which came from the officer entrusted with the alternative survey, should, I think, be a warning note to those interested in the undertaking to pause before it is too late to mend. I am further informed that the present accommodation at Asansol will more than suffice,—and that admirably,—the requirements of the Bengal-Nagpore Railway; and that the foundation of the bridge across the Damooda river on this—alternative—line will find a firmer and in all respects better bedding. The only circumstance that may be urged in favor of the Sitarampore route is the ensurance of coal traffic which ranges between 200 and 300 tons per diem. This quantity at present finds its way to Barakar and Sitarampore, and a representation on the part of coal companies to the E. I. R. might induce it, either to put in a branch from Sitarampore, or take over and extend a branch line belonging to a private firm now in operation.

BLACK DIAMOND.

Notes and Queries.

R. F. C. writes :—"*Ryles Method of Painting and Varnishing.*" Might not your article so headed have said simply that Mr. Ryle finds "Japanning" cheaper in the long run than "Painting ?"

H. W. (Darjeeling) writes :—I see a notification in your *Journal*, dated 5th instant, referring to the Cooper's Hill Forest examination. In the notice it is stated that successful candidates *will proceed* to Cooper's Hill. I imply from this that the examination will be held in India—is this so ? and can you give me any further particulars on the subject or direct me to whom to apply for them.

[*Ans.*—It is announced that an open competition for the Forest service in India, will be held in London in June next, when not less than ten probationers will be selected. The examination will be open to all natural-born subjects of her Majesty, but they must be unmarried, and above 17, but under 21 years of age on the 1st of June 1887.]

Literary Notices.

BULL'S PATENT TUBULUR TILES AND METHOD OF MANUFACTURE.

This illustrated pamphlet is issued by the patentee—W. Bull, A.M.I.C.E. The patent purports to meet the desideratum of a cheap and good roofing tile for India. It is claimed that these tiles are lighter, cooler, and stronger than any of the other kinds used in the country. From a perusal of the pamphlet we are disposed to endorse this view, as the principle of manufacture is such as what must ensure an economieal and water-tight roof covering, with other advantages, for tropical climates.

THE RAILROAD AND ENGINEERING JOURNAL.

We have received the *first* issue of this new publication. Mr. M. N. Forney, well known in the American Railway world, having become the owner and Editor of the *American Railroad Journal*, established in 1832, and of *Van Nostrand's Engineering Magazine*, the two publications have been consolidated with the title of the *Railroad and Engineering Journal.* The Journal in its new form is an illustrated monthly publication, having more the character of a magazine than of a trade journal. It is creditably got up and bids fair to become a valuable addition to American technical serial literature.

TRANSACTIONS OF THE NORTH OF ENGLAND INSTITUTE OF MINING AND THE MECHANICAL ENGINEERS.—Vol, XXXV, Part IV.

The November (1886) issue of these Proceedings contains only one Paper and that is on "Coal-mining in New Zealand" by Mr George J Binns, Government Inspector of Mines in the same Colony. The Paper is profusely illustrated and concludes with the following general remarks :—In looking at the quantities of coal in New Zealand, it will be observed that they are comparatively speaking, small ; also that the fields are much broken, having partaken in the geological disturbances of the country to some extent. But what strikes anyone accustomed to the English coal-fields is the inconstancy and unreliability of the deposits. In addition to the ordinary dislocations, the seams vary in thickness and in quality, so much and so capriciously, as to seriously retard the ordinary operations of mining. The high price of labour, and the variable demand—which is not dependent, as in older countries, on extensive manufactures—are also inimical to success. Thus it is, that although carried on for a good many years, coal-mining has not so far become an attractive investment for New Zealand colonists. There are, certainly, instances of successful working and large profits, but these are, unfortunately, very few in comparison with those cases where hope deferred has rendered the heart of the investor sick ; and, in the past, many and disastrous failures have been chronicled in the history of the coal industry of the Colony. One great cause of this want of success is the keen competition maintained by the collieries of Newcastle, New South Wales, which has been already referred to. Until the ports of the West Coast are much improved there can be no hope of driving the foreign article from these markets.

The President's valedictory address is replete with interest. If touches upon a variety of topics embraced by or contracted with the scope of the Institute. We glean therefrom that the deepest bore-hole in the world, until recently, was that at Schladebach, near Leipzig, the depth being 4,515 feet. The Schladebach hole was bored by the Prussian Goverment with the diamond drill in search for coal. The temperature of the bottom of the bore-hole is stated to have been 48° centigrade, or 118° F. It is stated however, that there is now a bore-hole in Pennsylvania which has reached over 6000 feet in depth.

The deepest shaft in England is that of Ashton Moss Colliery in Lancashire, 2,880 feet ; and elsewhere, that of the Adalber Lead Mine at Prizibriam, 3,672 feet. The depth of the celebrated consolidated Virginia Mine is 3,100 feet, and here the temperature was found to be 115° F., so that the workmen could only work for twenty minutes at a time, and then returned to a chamber filled with ice, thus working 2¾ hours out of 8. This seems, therefore to approach the limit at which any mine can be worked. The Virginia Mine however, yielded over 12 million pounds sterling worth of gold and silver in six years.

On the question of the amalgamation of Mining Institutes, the President observes that whilst any attempt to amalgamate the various Institutes into one body would be difficult, if not impossible, it is the opinion of all who have considered the question, that a federation, confined chiefly to the publication of the Transactions, could be carried out with great advantage. This would place the Papers read at each Institute in the hands of all mining engineers, would prevent needless repetition of Papers, and duplicate investigations and experiments by committees on special subjects of interest. An Institute which represented the whole mining science of Great Britain would be a source from which the Government might obtain reliable information of the real practical requirements for necessary legislation, and would be a power to resist any proposed legislation not calculated truly to benefit the real interests of both mine-owners, managers, and workmen ; and he hopes that this matter will receive due consideration from his successor, and that, with his powerful influence, a successful issue may be arrived at.

The Number concludes with the usual Abstracts of Foreign Papers and of Proceedings and other appended matter.

General Articles.

MEMO. ON BRIDGE OVER THE DEGH NULLAH ON THE LAHORE AND SHEIKHOOPOORA ROAD, IN THE PUNJAB.

By Rai Bahadur Kunhya Lall, M. Inst. C. E., late Executive Engineer, Lahore Division, Public Works Department.

The Degh Nullah, at its intersection with the above Road, is confined between two bold and defined banks and the soil of its bed, at that place, consists of a mixture of sand and clay, the former predominating.

A Bridge of three openings of 40 feet each, as per plan accompanying, is constructed over this Nullah, which has been found ample for the flood discharge of the Nullah during the last 16 years.

The Bridge is a timber structure on masonry abutments, and timber piers, and consists of nine strut and straining beam trusses (three in each bay) which carry the roadway beams and planks.

The roadway beams consist of two pieces joined with flitches on both sides bolted together over the middle of the straining beams, which are thus relieved of a portion of the superincumbent weight, and which cannot consequently sag.

The roadway is 12 feet wide between the wheel guards, and 14 feet between the parapets, with projections measuring 7′ × 2′ over each pier for the convenience of travellers passing over the bridge.

The abutments rest on wells sunk 20 feet below the bed of the Nullah and the piles of the timber piers are driven to the same depth.

The abutments, wing walls, and parapets are of dressed *pucca* masonry of large well burnt 12″ × 6″ × 3″ bricks set in mortar made of kunker and stone limes mixed in the proportion of 90 parts of the former to 10 of the latter, and the whole well ground in regular mortar mills.

The foundation wells are made of small bricks laid in fresh burnt kunker lime mortar and filled with concrete consisting of broken bricks with enough mortar to turn the whole into a solid mass.

The piers and superstructure of the Bridge, consist of the best well seasoned *deodar* timber, free from sapwood, flaws, and large knots, the parts in contact with masonry being tarred, and the remainder covered with two coats of black paint in linseed oil.

The struts of the trusses abutt against blocks of hard "keekur" wood which are placed at right angles to the struts, which are mortised into them.

The dimensions of the different timbers, &c., are given in full detail on the plan.

The whole of the Bridge is built of timbers not exceeding 15 feet in length, with the exception of the uprights, piles, and roadway girders, for which 20 feet timbers and a few 24 feet ones were used.

The Bridge cost Rs. 11,183 as per abstract annexed, which gives a rate of Rs. 99 or say 100 per foot run of waterway.

Abstract of Cost.

Quantity	Particulars.	Rate.	Amount.	Total.
		Rs. As. P.	Rs. As. P.	
14,117 c.ft.	Pucca Masonry of abutments and wing walls ,,	20 0 0	2,822 0 0	
3,150 ,,	Filling wells with Broken Bricks %	2 0 0	63 0 0	
5,12[illegible] l. ft	Sinking wells ,,	8 0 0	410 0 0	
3,435 c.ft.	Wood work ft.	2 0 0	6,870 0 0	
620 lbs.	Iron work 80 lbs.	16 0 0	124 0 0	
1,160 ,,	Iron work 80 ,,	14 0 0	203 0 0	
4 No.	Curbs for wells each	30 0 0	120 0 0	
24[illegible] r.ft.	Railings for Bridge ft.	1 1 4	261 0 0	
1,750 c.ft.	Kunker Metalling of Roadway %	12 0 0	210 0 0	
	Straightening of Nullah		100 0 0	
				11,183 0 0
	Grand Total Rs.	...	...	11,183 0 0

Calculations of Strength of Trusses.

Central interval between trusses ... 5 feet
Distance from abutment to head of strut ... 12·5 ,,
Length of straining beam ... ... 15 ,,
Rise of trusses ... ... 6 ,,
Weight per 1 ft. superficial of roadway ... 300 lbs.
Then, weight acting vertically at head of each strut $=(7{\cdot}5+6{\cdot}25)\ 5\times300=$ ... 20,625 lbs.
Length of each strut $=\sqrt{12{\cdot}5^2\times6^2}=$ ... 14 ft. nearly.
Strain in direction of strut $=20625\times\frac{14}{6}=$ 48,125 lbs.
Strain in direction of straining beam

$$=20{,}625\times\frac{12{\cdot}5}{6}=42{,}969 \text{ lbs.}$$

Resistance of strut $=12''\times12''\times350$ lbs. $=$ 50,400 lbs.
,, of straining beam $=12''\times12''\times350$ lbs. $=$ ... ... 50,400 lbs.

The struts and straining beams are therefore made 12″ × 12″ each, and are amply strong.

Roadway Planks.

Strain $=5\times1\times300$ lbs. $=$ ... 1,500 lbs.

$$\text{Strength}=\frac{4{\cdot}5^2\times12\times500}{10\times5}= \quad ... \quad 2{,}430 \text{ lbs.}$$

Uprights of Piers.

Strain $=40'\times12'\times300$ lbs. $=$ ... ... 144,000 lbs., which being divided by 3 gives 48,000 lbs. for the strain acting vertically on each post. Resistance of each post $=12''\times12''\times350=50{,}400$ lbs.

The scantlings given to the principal timbers of the Bridge are therefore ample.

Calculations of Waterway and Velocities of the Degh Nullah on the Lahore and Sheikhoopoora Road.

Mean sectional area of Nullah = ... 1,075 s. ft.
(Mean of areas at site of Bridge and at points one mile above and one mile below the Bridge.)
Mean Border of ditto = ... 115 ft.
Breadth of Nullah at top = ... 112 ft.
Fall of bed in ft. per mile = ... 3 ft.

which gives 1 in 1,760 or $\frac{1}{b}=\frac{1}{1760}$ or $b=1{,}760$.

R, or mean hydraulic depth $=\frac{1075}{115}=9{\cdot}35$ ft. $=$ 112 ins.

$$\text{Mean velocity } V=\frac{306{\cdot}55\,(\sqrt{R}-{\cdot}10325)}{\sqrt{b}-h.\ \ l.\ \sqrt{b+1{\cdot}6}}-{\cdot}31\,(\sqrt{R}-{\cdot}10325)=\frac{306{\cdot}55\ \ (\sqrt{112}\,{\cdot}10325)}{\sqrt{1760}-h.\ \ l.\ \sqrt{1760+1\,6}}-{\cdot}31\ \ (\sqrt{211}-{\cdot}10325)=6{\cdot}76 \text{ ft. per second.}$$

$$\text{Required waterway in l. ft.}=\frac{L\times V\times1{\cdot}097}{v}=\frac{112\times6{\cdot}76\times1{\cdot}097}{7^*}=120 \text{ ft.,}$$

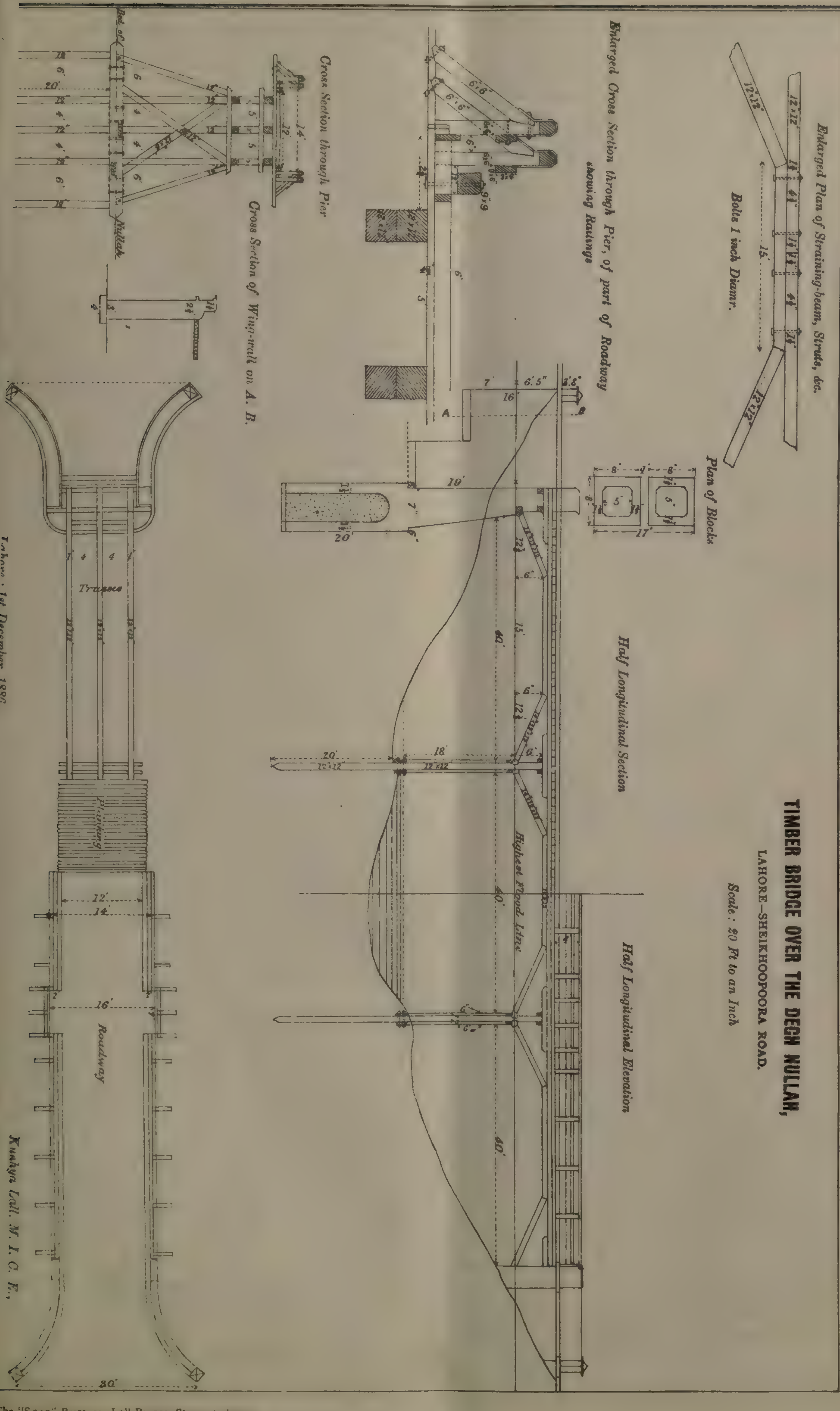
which gives 3 openings of 40 feet each.

As the Degh Nullah is a very violent and rapid stream in the rains, ample waterway has been allowed, so as to save the Bridge from damage or destruction during floods and to allow the whole of the flood water to pass through the Bridge without any turmoil, &c.

Lahore: 1*st December*, 1886. K. L.

* 7 feet being the assumed increased velocity under the Bridge.

The Progress of the Art of Tunneling.—A French writer directs attention to the constant progress made of late years in tunneling and drifting through rock. Along with improvements in rock drills have come no less marked improvements in explosives. The results have shown themselves in a constant increase in the rate of advance. Thus, in the Mont-Cenis tunnel the average rate was 1·75 meters a day. In the St. Gothard tunnel, where more powerful explosives were used, the rate was 2·75 meters. In the Arlberg tunnel further improvements in the drills and explosives used, with a better organization of the work, raised the rate of daily advance to 4·15 meters. More recently the Levant tunnel was driven at a rate of 4·50 meters a day. And the last great work of this character, the Carrito tunnel in Italy, *where* BLASTING GELATINE *was used in deeper holes than dynamite could work in effectually*, shows an average daily advance of 5·40 meters. Some allowance must, of course, be made in these estimates for difference of rock and other conditions of the problem; but as these averages are for the whole work, they represent approximately the progress made in the science and practice of mining since the completion of the Mont-Cenis tunnel.



The "Star" Press, 19, Lall Bazaar, Street, Calcutta.

APPENDIX TO "DRIFT IN GUN-FIRE."

By A. Ewbank, M.A.

I regret that owing perhaps to an over conciseness in my introductory remarks on "drift" Mr. Hilton has been led to misconceive so entirely the direction of *my* drift. I introduced the case of a spinning projectile moving over an unspinning earth. Mr. Hilton interposes with the case of an unspinning projectile over a spinning earth. The former let us call artillery drift. The latter let us call earth-rotation drift. This latter drift was omitted from the discussion as being unimportant to the gunner.

Suppose we have a given gun fired at a given elevation with a given charge of powder and a given projectile. Let the gun be located at a given spot, say the neighbourhood of Calcutta. If the projectile is fired in the north azimuth it will have a tolerably large artillery drift to the east. It will also have a small earth-rotation drift to the east. Therefore the observed drift will be the sum of the two. If we could watch the earth-rotation drift—by using a cannon not rifled—we should see that this drift is greater in the latter half of the flight. This statement I leave unproved. Secondly, let the projectile be fired due south. There will be the *same* tolerably large artillery drift still to the right, which now means to the west. There will be an earth-rotation drift approximately the same as before and now also to the west. Again, the total drift is the sum of the two. The earth-rotation drift is now more marked in the *former* part of the flight. This statement is also left unproved. Thirdly, let the gun be pointed due east. The artillery drift—constant in amount—is now measured to the south. The other drift has disappeared. This drift also vanishes for an azimuth due west. For any fifth azimuth the drift takes a value which varies with the azimuth.

Now the gunner in battle cannot choose his azimuth. He must fire in whatever azimuth the enemy choose to show themselves. It is worth his while to study the artillery drift—not because it is large but—because it is constant. It is useless to study the other drift—not because it is small but—because it is variable and because its variations take it down to zero. Not yet is the case against this latter drift—as a claimant for the gunner's meditations—fully stated. For not only is the drift variable when at a given spot of the earth we change the line of fire, but if we transport the gun to another part of the world we have a new set of changes which are usually different from the former set. A field piece is made near London and is tried—let us say—at Shoeburyness. Its artillery drift is found by practice and is duly recorded. This may be done by firing east or west. If it is thought worth while to determine the maximum earth-rotation drift *at* that place; we might now fire the gun due north and find the *increase* in the drift. This being done and the result entered in the gunner's note-book war breaks out with Russia and he and his gun are landed somewhere in the Caucasus. The gunner must now get a fresh set of memos either by theory or by practising in the Caucasus. In Burmah he will want a new collection, but at the equator this drift is zero not only due north but for all azimuths.

But not even yet is the case against this small drift fully formulated. For suppose a big cannon lodged in a fortress and fired always in one and the same vertical plane. Here, if anywhere, might this drift sue to be allowed a recognised status. Unfortunately even now there enters an insurmountable "demurrer"—in the shape of a casual side wind. Let the pure artillery drift be taken as a feet. Let the earth-spin drift be e feet, where e may be a proper fraction. Let the accidental wind drift be called w. This may act to the right of the line of fire. But it is just as likely to act in the other direction. Thus the total—the observed—drift is $a + e \pm w$. Now e is small and it may be less than w. Where then is the use of being particular about your e if you cannot regulate or predetermine the magnitude of your w? If earth-spin drift were constant for all directions at one place—even though it continued to vary when the latitude was varied—*and* if this drift were some considerable fraction of the pure artillery drift, then it might be worth while for gun-makers to change the direction of their rifling. For with a left-handed spinning projectile the artillery drift would be one way and the earth-spin drift the other. Thus the original line of fire would be kept more closely than it is with the present mode of rifling.

Practically in action a field piece is aimed not at one man, but at an extended line of men. Here close accuracy of aim is not very important. In the siege of a town when a gun is used to throw shells or round shot over the walls and among the buildings accuracy is still unimportant. By turning the gun its shots can be distributed with as much impartiality, or concentrated with as deadly effect as if the drift was *nil*. If, on the other hand, the gunner has to strike one particular part of a visible object—as for instance to effect a breach—his gun with a predetermined drift is about as effective as would be a gun with no drift. Similarly, in an observatory a clock that gains uniformly or loses uniformly is considered nearly as useful as a clock that keeps perfect time. We cannot make a clock that absolutely neither gains nor loses. We therefore limit our endeavours to making the gain or loss constant and definable. We cannot get rid of drift. So we content ourselves with determining its larger and its *constant* components.

Readers of the original article are desired to make the following corrections:—On page 68 for "a line on it" read "a line in it." On page 93, left column, second paragraph, for "a clockwise on right handed" read "a clockwise or right handed," In the same paragraph for "through P and A about" read "through P and about." In right hand column at the top for "the curvature at C the highert point is less" read "the radius of curvature at C the highest point is less." Or simply change "less" to "greater," which comes to the same thing. On page 94, third paragraph, for "it has this effect when combined with the vertical spin" read "it has no effect when combined with the vertical spin."

With regard to the effect of the earth's rotation upon the courses of rivers the reader may consult a lecture on "The Living Earth" shortly to be published in these columns.

A. E.

Garson's Suspension Bridges, described and illustrated in our last issue, are made by A. & J. Main & Co., and not by A. W. V. E. Main & Co., as mentioned in the article.

The Directors of the Suez Canal Company announce that from the 1st of March, steamers carrying electric lights will be allowed to pass the Canal at night.

M. Bonatale, Minister of Public Works in Persia and Baron Normann, engineer in the Persian service, have gone to Moscow with the alleged object of promoting a Russian society for the construction of railways in Persia.

A Russian Merchant, M. Nicolaieff, is said to have laid a scheme before Prince Dondoukoff-Korsakoff for the construction of a steam tramway, 153 miles long between Askabad and Meshed, in order to facilitate the placing of Russian goods on the Persian market, to the exclusion, of course, of English manufactures. The road is to take the place of the *chaussée*, which was to be constructed according to the Teheran Convention of 1881.

We hear that the Hong-Kong and Whampoa Dock Company have practically concluded a contract with Messrs. Marty and D'Abbadie for the construction of three river boats for the river service of Tonkin. These three boats will be built after the style of the *Powan*. The length of each will be 132 feet, the beam 26 feet and the depth 8 feet. They are to be made to hold 175 tons merchandise, about 500 native passengers, third class, 100 second class passengers and 16 first class passengers. We believe the contract price for the boats is something near $48,000 each.

At a meeting of the Geographical Society of Paris in December last, M. de Lesseps again declared that the Panama Canal would be open for traffic in 1889. He added: "There will not be sufficient time for the construction of locks; we shall make them later on. The essential point is that by the date mentioned shipping shall be able to pass through the Canal."

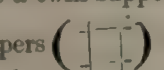
TRANSPORTING WAGGONS OVER BREAK IN EMBANKMENT, E. B. S. R.

THE floods last year in some parts of Eastern Bengal surpassed the inundations of the year previous. The river gauge readings of the Brahmapootra were higher by several inches and the inundations proportionately greater. The district about Goalundo suffered severely. The E. B. S. R. terminus was cut off for six weeks. A new bridge of six spans succumbed bodily to the enormous pressure of water. The floods would not be refused; the bridge staggered for thirty-six hours and then was swept away. Engineering skill and mountains of stones availed nothing. On the morning of the 13th September, the first inroad was made by the rushing waters. On the morning of the 15th the waters roared in mockery at the sustained efforts made to restrain them: one pier alone remained with bent head in token of respect to the mighty power which had levelled its brethren in distress, and the waters seethed and foamed where but yesterday trains had run.

The railway authorities stood on the morning of the 15th September, at the very busiest time of the year, with an impassable break between Calcutta and the principal goods terminus. The focus to which converges the river-borne traffic of nearly half of Bengal, was an island. Goalundo, ravaged by the river from its birth as a railway terminus, had never before been cut off as it was now.

It is not within the scope of this paper to detail how the authorities worked the congested traffic in goods, or how they kept open the passenger traffic. That the first did not suffer is borne out by the earnings of the lines for the half-year. That the convenience of the travelling public was studied is evidenced by the total absence of all complaints—in fact, Calcutta did not know that a break existed.

Our immediate purpose is to show the manner of, and the means by which, the release of a large number of rolling-stock was effected, in order that railways which might be unfortunate enough to be similarly circumstanced, might minimise the disastrous results, by adopting similar measures.

On the sometime Island of Goalundo were blocked over 150 vehicles of sorts, representing a carrying capacity of nearly 1,500 tons and a money value in demurrage alone of something like Rs. 1,200 *per day*, or, say, Rs 35,000 per month. The diagram on the opposite page shows clearly how the waggons were released from their watery thraldom, and utilised for the traffic of the lines. Two cargo-boats were transversely cradled—boxed together so as to give a twin support to a single platform; piers of crossed sleepers () built up from the bottom of the boats gave the required bearings. Beams were laid athwartship; on these beams, gauged to the parent line, were laid rails, and the whole lashed and bolted to the required rigidity. There were three sets of rails to take two waggons per set. The joined pontoons were now ready as a treble-section of the main line.

Next in importance comes the work of laying out the anchors, so as to have the boats under complete control, in order to move this floating section of the line from side to side over a sluicing current to be connected to the severed ends of the parent line. The diagram shows how kedges and breast lines were laid out. Cross head-ropes bore the weight of the boats against the current; side shore lines guided the boats into the positions required; stern kedge lines steadied the boats and assisted generally in manœuvring them.

The bridge ends demanded the most careful levelling in order to maintain the level between the rails on board the boats, and those on shore, and the greatest care and judgment were required to side the boats in, so as to fish plate the first set of rails, then the next and then the third; when each in turn had been connected and the waggons shipped, the floating section was disconnected and hove across to the other side, where the same careful work had to be done to unship the waggons and free them.

It will be observed from the diagram that one pier remained, the rush scoured out behind the abutment, and the work of transhipment had to be done on the north end by a rear movement of the boats inside the screen wall of the bridge, thus adding to the difficulties of the operation and delaying greatly the work.

Nevertheless, 141 vehicles of all classes and tonnage were crossed in six days without a scratch and without any accident to life or limb, at a cost under all heads, including hire of the boats, of a little over one day's demurrage per vehicle. This operation was initiated, planned and carried out by the District Traffic Superintendent at Goalundo.

The bridge levels were maintained by the Executive Engineer.

H. H. THE NIZAM'S SARUNAGAR PALACE, (HYDERABAD—DECCAN).

THE Palace as designed is in the Saracenic style, and is in four blocks, with courtyards intervening between them, but connected along the sides by corridors. The blocks consist of the main building, the quarters for His Highness' companions or Masahibs, His Highness' Private apartments, and the Zenana accommodation.

The main building consists of a central block, containing the public reception rooms on the ground floor, and six suites of bed rooms above, which may be converted when necessary into twelve bed rooms. On both sides of the ground floor are corridors leading to wings, each consisting of a suite of reception and bed rooms.

Immediately to the rear of the central main block, and separated from it by a courtyard measuring 200 feet by 100 feet, is a block of buildings intended for the use of the Masahibs, and consisting of a reception room, a dining room, and four suites of bed rooms convertible when necessary into eight bed rooms. This block is connected with the main building by corridors on both sides, in the centre of which are the gate-ways which form the public entrance to the Palace, while the spacious courtyard just alluded to forms the carriage drive.

Entering the building from the courtyard is a vestibule 30 feet by 30 feet, and then a hall 42½ feet by 30 feet. On the left is a billiard room and a morning room each 45 feet by 30 feet, and separated by a passage 15 feet wide. On the right is a dining room 110 feet by 30 feet. The drawing rooms may be entered from any of the rooms just mentioned, and with the exception of the hall, are separated from these latter by a corridor which extends throughout the length of the building. This corridor is 411 feet long, and forms the approaches to the side wings alluded to. The drawing rooms are three in number, forming a suite 125 feet by 30 feet. They are sheltered by a verandah 15 feet wide, which opens immediately on a garden 700 feet long and 500 feet broad.

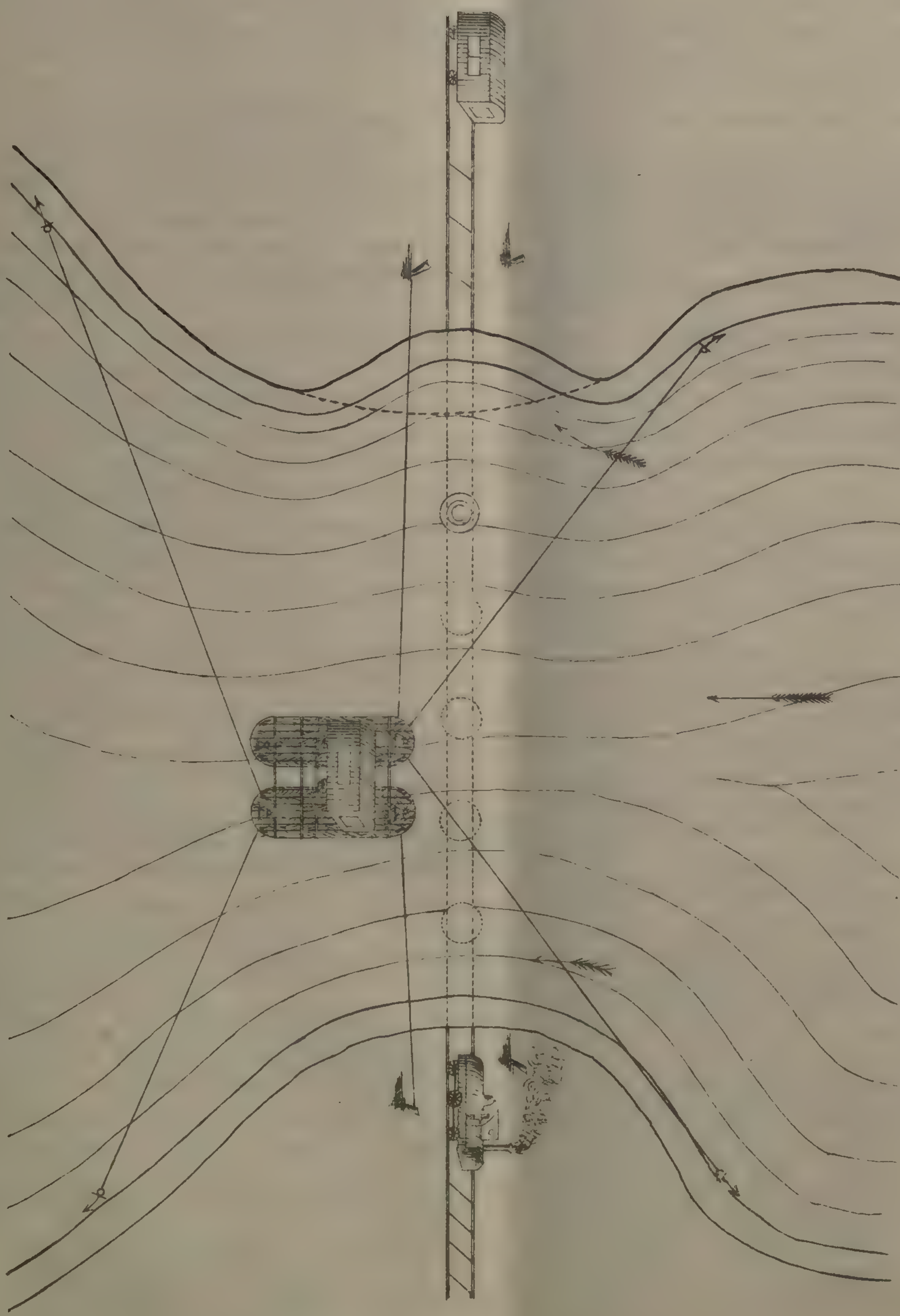
Behind the block for the Masahibs, and separated from it by another courtyard of similar dimensions to the one already described as forming the carriage drive, is His Highness' block of private apartments. These consist of a reception room on the ground floor, 60 feet by 30 feet, with bed rooms above. The whole looks out into a large quadrangle about 300 feet square, round three sides of which are arranged the apartments for the Zenana ladies, while His Highness' own apartments form the fourth side. Provision is made for private access along the upper corridors from the Zenana to His Highness' apartments, and to the veranda adjoining, which commands a view of the gardens and the grounds beyond.

Corresponding to the side wings which open out from the corridor of the main building, and situated behind them in a line with the block for the Masahibs' quarters, are two similarly designed blocks, but differently arranged inside, the one comprising the kitchen, and the other the accommodation for His Highness' private offices. The

TRANSPORTING WAGGONS

Over break in Embankment,

E. B. S. R.



The "S[illegible]" Press, 19 Lall Bazar Street, Calcutta.

kitchen is in two distinct buildings, the one for Moglai and the other for English use.

The Zenana block opens out directly by a covered and private passage into another garden intended for the ladies. A private entrance for carriages leads into the Zenana courtyard.

The building is terrace-roofed throughout. The height of the rooms on the ground floor is 30 feet, and on the upper floor 20 feet. The main building is surmounted in front and rear by a large dome over the central portion, and two smaller ones over the stair-case rooms. All the gate-ways carry towers, the most imposing of which are over the gate-ways forming the public entrance to court-yard No. 1.

The rough estimate for the Palace and grounds was calculated at 12 lakhs of rupees, and it was proposed to distribute this amount over 3 years, but as the laying out of the Garden, Park, &c., would take a longer period, the time was extended to 5 years—the first-half of which has already expired.

RANGOON DRAINAGE PROJECT.

(Continued from last issue.)

Specification of Engine-House, Boiler-House, and Chimney, for Sewerage Works.

Engine-House.

The engine-house to be 60 feet long and 30 feet wide, and to contain two brick and stone work foundations for two pairs of engines and air compressors, 16 feet by 19 feet 6 inches, and 9 feet high.

The ground to be excavated 6 feet deep for the walls, and 45 feet by 30 feet to be excavated as a cellar round the engine foundations to the same depth.

Part of the wall adjoining the boiler-house to be excavated 7 feet deep for the boiler flue.

The whole of the excavated cellar space to be covered with 18 inches of concrete, consisting of one part of cement, four parts of sand, and eight parts of broken stone, on which the engine foundations are to be built.

The walls of the engine-house to be 18 inches thick from the foot to the floor, and from the floor to the cornice $13\frac{1}{2}$ inches thick ; to be built of best grey stocks, or other bricks of similar quality, and the whole of the building to be faced with good red bricks.

The surface to be pointed with cement.

The engine foundations to be built of best grey stocks in cement, and the top of the foundations of good sandstone blocks 18 inches thick.

The foundation bolts for the engines to be put in as directed by the Engineers.

The floor of the engine-house to be level with the top of the engine foundations, to rest on wall plates 4 inches by 4 inches as shown on drawing.

The front entrance to be provided with a staircase of good sandstone, having 10 steps with 6 inches rise and 12 inches tread, and 8 feet wide, and a landing of 6 inches rise and 3 feet in width.

The sides of the staircase to be of good sandstone of the shape shown on the drawing.

The engine-house to have 12 wrought-iron windows 4 feet wide and 12 feet high, with semi-circular tops, and glazed with ordinary window glass.

The principal entrance to have a double door 4 feet wide and 9 feet high, with a semi-circular fanlight above.

The first 10 feet of the engine-house to be divided into three compartments by wooden partitions 16 feet high with a wooden ceiling.

The floor of the engine-house to be 5 feet 6 inches above the ground level, and the walls to be carried 20 feet above the floor.

The engine-house to be provided with an iron roof 30 feet span, 6 feet 9 inches rise, and with 12 sets of poloncean trusses.

The trusses to be bound together longitudinally by 10 angle-irons $1\frac{1}{2}$ inches by $1\frac{1}{2}$ inches by $\frac{1}{4}$ inch.

To all the angle-irons are to be fastened 4-inch by 5-inch purlins, each 61 feet long.

To these purlins are to be nailed 2-inch boards planed on one side, and moulded, grooved, and feathered.

The boards to be first covered with good roofing paper, and finally with countess slates laid with 3-inch lap, and each fastened with two copper nails.

A patent slab-crested roll to be put on the ridge.

The walls of the engine-house to be lathed, layed, and set, and afterwards coated with three coats of oil paint.

The whole of the engine-room to be wainscoted to a height of 3 feet 6 inches.

All the woodwork in the engine-house to be covered with three coats of boiled linseed oil, and not to be painted.

Boiler-House.

The boiler-house to be 42 feet wide and 25 feet deep, and to contain two boilers.

The foundations for the boilers to be excavated 30 feet long and 3 feet 6 inches deep.

The boiler-flue to be 5 feet wide and 3 feet 6 inches deeper, *i.e.*, 7 feet.

The walls to be 18 inches thick from the foot to the splayed bricks, 2 feet 6 inches above the ground level, the rest of the wall to be $13\frac{1}{2}$ inches thick, and carried up to a height of 16 feet above the ground level.

The brickwork to be of best grey stocks in lime and faced with good red bricks.

The outside to be pointed with cement similar to the engine-house.

The boiler-setting to rest on 18 inches of common bricks in clay. The rest of the foundations to be of best grey stocks set in lime, with the exception of the lower flue, which is to be lined with fire-bricks carefully set in fire-clay as shown in drawing.

The boilers to be fixed temporarily on wooden scaffolding by the boilermaker.

The bricklayer to build his flues up to the boilers as shown in drawing.

The floor in the boiler-house to be three inches above the ground level, and to consist of Buckley or Staffordshire bricks, laid in cement and resting on 6 inches of concrete.

The boiler-house to have two wrought-iron windows, each 4 feet wide and 8 feet high, with semi-circular tops, and one single entrance door 3 feet wide and 8 feet high, with semi-circular fanlight above, and a sandstone doorstep morticed to receive the door-posts.

The boilers to be covered with 2-inch boards, laid on suitable wall plates, so as to be easily removable.

From the top of the boiler a staircase of five sandstone steps to be made leading down to the engine-house, and a door 2 feet 6 inches wide and 7 feet 6 inches high to be provided between the boiler-house and the engine-house, having a sandstone door-step 2 feet by 4 feet wide and 6 inches thick, morticed to receive the door-posts.

The boiler-house to be fitted with an iron roof, 42 feet span and 9 feet 3 inch rise, in all respects similarly constructed to that of the engine-house, but to be fitted with a ventilator 3 feet high and 12 feet long as shown in drawing.

The inside walls to be rendered and set, and afterwards limewashed, with the addition of a suitable colour.

The front wall of the boiler seating to be finished with red bricks in the same mannner as the outside of the engine and boiler houses.

The Chimney and Flue.

The foundation of the chimney to be excavated 8 feet 6 inches deep.

The chimney to stand on a concrete foundation 16 feet square and 18 inches thick.

The main flue from the boiler-house to be carried through the chimney, forming a cleaning hole, and covered with a suitable iron man-hole plate.

The chimney to be 70 feet high and 4 feet inside diameter at the top.

The lower 20 feet to be square, 5 feet diameter inside and 27 inches in thickness in the main body of the brickwork, and to spread out below as shown in the drawing.

The shaft of the chimney to be octagonal and to have a batter of O: 3 inches to the foot, and to end in a cornice covered by a cast-iron cover plate or helmet.

The chimney to be built of suitable hard burnt bricks in lime, and the outside surface to be finished with red bricks similar to the engine and boiler houses.

The chimney to be fitted with a lightning conductor, projecting 5 feet above the top of the chimney, and made of $\frac{1}{2}$-inch copper wire carried down to the subsoil water level and fastened to a horizontal plate 3 feet by 3 feet of sheet brass No. 20 B.W.G.

(To be continued.)

PUNKAHS:

A Lecture recently Delivered at Bombay.

By J. Wallace, C.E.

(Concluded from last issue.)

(*Exp.* 4.) You will observe the effect on the keys of the indicator due to an alteration of the distance between the curtain and the keys; as it approaches the keys are violently depressed, as it recedes the movement becomes weaker until at a distance of two feet the effect is scarcely perceptible.

(*Exp.* 5.) I have provided a moveable bar embracing the suspending cords, and working in vertical guides, so that when raised or lowered it alters the length of the suspending cords, and enables us to see the effect produced. It is just now at the standard distance, but by lowering it a foot you will observe an increase in the speed of the punkah, and when reduced to twelve inches the pulls are increased to sixty per minute, while the length of pull is diminished to fifteen inches. The downward current is now much localised, and acts principally on the middle keys of the indicator.

This is evidently the kind of punkah to be used for one person; its effect is concentrated, and the power required for its propulsion is reduced.

I have prepared several models of punkahs, all of the same size, as regards width and depth, and we shall now proceed to test them, under conditions as uniform as possible, in order to see which is the best.

We shall adopt the standard length of fifty inches for the suspension cords, and that of nine inches for the space between the foot of the curtain and the keys of the indicator.

The motive power shall be a weight of two pounds falling a distance of thirty-six inches. This weight is lifted by hand, while the punkah makes the return swing, so the method of driving will give the nearest approximate to machine driving, which has so often been declared to be impracticable.

(*Exp.* 6.) We shall begin with the commonest form of punkah, a kilted curtain with a panel superposed. The falling weight strikes—its stops above and below, showing that it is doing its work exactly, and the white disks on the keys of the indicator facing you form wave lines which show you the effect of the current on each key.

(*Exp.* 7.) We shall now remove the curtain. The frame forms almost a line with the suspending cord as it swings, and the loss of effect on the indicator is very evident. The reason is soon shown.

(*Exp.* 8.) Turning the panel upside down so that the swing bar is at the top, the frame changes its angle in swinging and the wave lines of the indicator show a great increase of downward current.

(*Exp.* 9.) By removing the panel and attaching the curtain above, we find that it does as much work as they did both together, showing that the panel is not only superfluous as an adjunct to the curtain, but a positive detriment, as it absorbs a certain amount of power to drive it.

The kilted punkah is an elaborate structure, with kilted double sides, and a sandbag suspended on a plain web between. Let us see by comparison the advantage of all this millinery.

(*Exp.* 10.) Here is a plain piece of dungaree cotton cloth, with a stick of wood serving as ballast at its lower extremity. Its value is now evident by the movement of the indicator, which is equal, if not greater, than that of the last experiment. We may, therefore, conclude that the kilting, and all the lavish display of calico, have no practical value.

There is yet one more punkah to try in order to complete these experiments. We want to see if the weight hung at the bottom of the punkah would be any more effective if distributed throughout the depth of the curtain. We shall, therefore, try what might be called, for the sake of distinction, a fishtail punkah. It is of double calico, quilted in horizontal lines: the weights are wires running parallel through the quiltings. The indicator tells us of no material advantage in this special form, and, reviewing the experiments just concluded, some surprise may naturally be felt at the conclusion forced upon us that such a variety of types of punkah, working under uniform but favourable conditions, should show such a small difference in their effect.

The explanation is, I think, to be found in the slow speed at which a punkah works, when compared with the velocity of other blowers driven by steam or by animal power. The friction that would tell rapidly on the irregularities of an object moving through the air at the rate of hundreds or even thousands of feet per minute, is hardly sensible in the power required to propel the slow moving punkah.

The force used during the comparative experiments has been equal to two pounds falling 72 feet per minute, which is equivalent to $\frac{1}{229}$th of one horse-power; and as all the punkahs were just three feet long, a simple calculation will show that one horse-power would suffice to drive 114 of similar punkahs, each six feet long.

Punkahs should be made always with a plain surface, of any material from cotton or linen to silk or velvet, and of a depth of from eighteen to twenty inches. The colour of the material should harmonize with those of the room in which it is to hang. The swing bar should be of iron, one and a quarter inch thick, and covered with leather or leather cloth, with the seam on the lower side to form an attachment for the curtain which should be weighted with swan shot on its lower edge, and finished, if desired, with a very light fringe. The weight should be just sufficient to cause the curtain to assume a hollow curve on the side advancing against the air. Strong whipcord or log-line is the best material for suspension, and the hooks should be proportioned to the weight they carry, that is to say, about one-half the usual size. The cord should be protected from contact with the hooks by means of a "thimble" or brass eyelet. The pulling cord should be thickened where it is pulled by the addition of a couple of feet of cotton tent rope. Decorations of any kind should be added with a very sparing hand as they are liable to give the punkah a heavy appearance.

The application of mechanical power by means of a spring, or a falling weight and clockwork, to drive a punkah for a certain time without attention, has often been talked about, and even attempted on a small scale, but nothing of any importance has, so far, been done towards solving the problem in a practical manner.

A punkah 5 feet long suitable for a bed would require, in order to work eight hours, a force equal to 21 cwt. falling 30 feet during that period; and a common palm leaf hand fan to work one hour would require a force equal to 154 lbs. lifted one foot. These forces are very small: the greater of the two could be easily wound up by a man in sixteen minutes, and yet the difficulties in the realisation of this method of driving, *at a moderate cost for apparatus*, have not yet been overcome.

If we could only utilise *all* the heat of the fuel we burn in order to obtain power three-fourths of an ounce of kerosine would supply the requisite force to drive a punkah for eight hours.

Mr. Edison has still about two years left in which to complete his self-imposed task of finding means to convert the heat of coal directly into electrical energy without the intermediary of a steam engine and a dynamo, and we may rest assured that this problem will have ample justice done to it by one of the most talented and original thinkers of his age.

In the meantime there remains the system of propulsion by means of storage batteries, which has already been applied to various other purposes and which appears to be well adapted to the needs of such a city as Bombay. If the Electric Light Company at present defunct is resuscitated, there is profitable work to be had for its machinery during the day in charging storage batteries destined to propel our punkahs during the night.

The distribution of electric force by a well-organised establishment would resemble in so many points the distribution of soda water, not excepting the return of the empties, that the public would have no new habit to acquire, but only a new comfort to adopt.

In default of electric power we may turn to water power as a motor, but we are immediately met by the difficulty due to the irregularity of the pressure in the service mains, which renders it unreliable as a source of power during the night in Bombay. The authorities, however, promise that in about two years a pressure of about 33lbs. per square inch will be maintained, night and day, in the mains, and then by means of a small turbine or other motor we may be independent, equally of punkahwallah and mosquito curtain, at the expense of about seventy gallons of water per night.

London has for some time had a company for the distribution of hydraulic power by a special service of mains, and the promoters of this company encouraged by their success have recently applied for powers to establish their system in Manchester where small industries are very numerous. Water offers one of the safest and simplest means of dis-

tributing power in small quantities, and it seems to succeed wherever it is tried.

In addition to the sources of power already mentioned, there are the steam engine, the gas engine, the petroleum fired engine, the petroleum gas engine, and the hot-air engine, all of them suitable for driving punkahs in such numbers as would be required in hotels, clubs, hospitals and blocks of offices or dwelling houses.

It is certainly a matter for surprise that a wealthy and enterprising city of the magnitude of Bombay, should be without an example of a large building possessing a well-organised system of mechanically driven punkahs.

The distribution of ice in this city is second to none in the world in point of price and quality, and yet it has less importance, as a necessity, than any means by which we may be enabled to enjoy refreshing sleep in the hot season and rise invigorated for our daily duties.

The effects of a hot climate tell more on the human system during the night than during the day, and any rational method of combating its ill effects deserves our best consideration.

It is with a desire to present the principles and structure of the punkah in a popular form that I have brought the subject to-day before you.

NOTES FROM HOME.

(*From our own Correspondent.*)

From the reports and accounts of the Railways for the last half of 1886 that have so far been published, it is satisfactory to see unmistakeable tokens of the improvement in the trade and prospects of the country. The increase in the distribution of dividends applies not only to passenger lines represented by the Brighton, Metropolitan and the South Eastern, but also to the Manchester, Sheffield and Lincolnshire Country, which is a mineral and manufacturing line. In the latter case the report says that the extreme point of depression has been reached and the new year opens with better prospects for the Railway shareholders. The Directors of this line have perhaps as good opportunity as any of forming an accurate opinion of the subject. There is a marked decrease shown in the expenses of all these Railways, the chief saving figuring in most cases in the locomotive department owing to the low price of fuel. In one case a saving of nearly £2,000 in "oil and tallow, &c.," draws one's attention to the importance of this expenditure in the working of Railways. It may be therefore interesting here to note that the annual consumption of oil upon the railways of the United Kingdom is computed to cost:—For the Engineers' department, Locomotive department, including Running Shops and Carriage lighting, Traffic department, General offices, &c., £370,000, or at, say, 6*d.* a gallon, 14,800,000 gallons a year. The average cost per train mile of "oil, tallow and waste" in the locomotive expenses is ·267*d.* per train mile. Oil by itself may be taken at about one-fifth of a penny per train mile. The inexhaustible supplies of Russian petroleum have already had an effect on prices of oil both for lighting and lubricating, and with a continuation of the production at the present rate further economies will, no doubt, be possible to the benefit of Railway shareholders.

Several successful experiments, which cannot fail to be of interest to persons engaged in Railway management, have lately been made on the Glasgow and South-Western Railway which forms a new departure in heating Railway carriages. One of the novel features in this is the fact that the jet of gas in the roof of the carriage is made to do the double service of producing light and imparting its heat indirectly to a current of air which is delivered near the floor of the carriage. In the first instance, the heat from the lamp is imparted to water from which it is communicated to a current of air which passes down through a tube in the partition of the carriage and is eventually delivered into the compartment in two separate streams underneath one of the seats. During the late severe weather the experiment showed that the small gas jet in use was sufficient to supply fresh air at a temperature of 54°.

In a paper read before the Civil and Mechanical Engineers yesterday, Mr. Campin compared the details generally of iron bridge works as designed in England and Foreign countries. The question of pin-connected structures was entered into with a view of showing that it is preferable to the rivetted joint system if the work is properly designed. Especial attention was also drawn to the construction of bridge floors, of which several kinds were described. In the paper the author takes the opportunity of criticizing the present system of engineering education. "Abstract principles," he says "are more widely studied, and in fact the scholar period of life is becoming more extended, the practical study of the work is delayed to a later age than formerly."

The Metropolitan Board of Works has accepted the tender for the construction of the great precipitating works at Barking Creek, which includes the northern outfall sewage works. Contract plans and specifications are in hand for the Cross Ness Works, which takes the southern sewage. The entire outlay for the two sets of works is reckoned at three-quarters of a million. Fine steamships of a special build will have to be constructed to carry off the sludge, or precipitated matter to the open sea. The precipitating process consists in the application of 3·7 grains of lime and 1 grain of proto-sulphate of iron to each gallon of sewage according to the process designed by the Board's chemist. During the summer heats, the effluent from the precipitating tanks will be further treated with manganate of soda and sulphuric acid. The annual cost is reckoned at £118,000 per annum, which includes capital charges and current expenditure. Experiments are now going on with a view of ascertaining the manurial value of the sludge, and so if possible obtain a demand and so save the shipment of it to sea. In the meanwhile an influential meeting of London ratepayers has just protested against the wasteful expenditure contemplated and calls for an investigation of the whole subject, with a view of more effectually carrying out the recommendations of Lord Bramwell's commission.

A most interesting experiment, the results of which will be of the utmost scientific value to engineers, and will be watched with corresponding interest is about to be tried in Birmingham. A company has obtained powers to supply power from a central station by compressed air through pipes laid in the streets. These powers extend over an area of between 485 square miles. It is intended at first to restrict operations to about 1½ square mile, which will include 23 miles of main pipe. The central station works are designed for the production of 15,000 h.-p, of which the engines laid down at first will supply 6,000 h.-p. To do this less than half the authorized capital will be spent at once. At a recent meeting of the Directors, it was determined to start clearing the ground and commence the foundations of the central station at once, so that by next summer we may see considerable advance made towards the realization of the subject. It is considered that Birmingham offers peculiarly the best field for such an experiment, inasmuch as it contains an enormous number of small workshops requiring minute amounts of driving power and often requiring it only intermittently during the day.

A very interesting question seems to have been successfully solved by American engineers, in the successful adoption of a new motive power—*viz.*, the vapour of bis-sulphide of carbon—to drive engines of considerable power.

In order to encourage the manufacture of worsted cloth, the Government of Victoria has offered a bonus of £5,000 for the manufacture of the first 10,000 yards of worsted cloth in the colony before the 31st July 1888. The cloth must be the manufacture of one mill only, permanently established in Victoria, and must be wholly manufactured from woollen yarn made in Victoria, of Victorian-grown wool.

GENERAL HINTS.

Oil of lavender will drive away flies.

Grained wood should be washed with cold tea.

Copperas mixed with the whitewash put upon the cellar walls will keep vermin away.

Ceilings that have been smoked by a kerosine lamp should be washed off with soda water.

Drain pipes and all places that are sour or impure may be cleansed with lime water or carbolic acid.

Strong brine may be used to advantage in washing bedsteads. Hot alum water is also good for this purpose.

The warmth of floors is greatly increased by having carpet lining or layers of paper under the carpet.

Cayenne paper blown into the cracks where ants congregate will drive them away. The same remedy is also good for mice.

If gilt frames, when new, are covered with a coat of white varnish, all specks can then be washed off with water without harm.

If a little salad oil is mixed with mustard for the table, it is greatly improved.

Moth-infested articles should be saturated in a naphtha or benzine. It injures nothing and kills the destroyer.

It soothes a feverish patient to bathe him with warm water, in which a little saleratus has been dissolved.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Madras, February 15, 1887.

The following transfer is ordered:—Mr. A. S. Russell, Executive Engineer, 4th grade, from the V. Circle, Presidency Division, to the VI. Circle for charge of the Tinnevelly Division. To join at the public expense on relief by Captain W D Lindley, R.E.

The following posting is ordered:—Captain W. D. Lindley, R.E., Assistant Engineer, 1st grade, to the V. Circle for duty in the Presidency Division. To join on return from furlough.

The following appointment is made:—M. R.Ry. R. Gopala Aiyar Avargal, B A., to be Assistant Engineer, 3rd grade, on probation, with effect from 1st April 1887.

N.-W. P and Oudh February 19, 1887.

Irrigation Branch.

Mr. W. P. Richardson, Executive Engineer, 1st grade, was employed on special duty in the Cawnpore Division, Lower Ganges Canal, from the forenoon of the 7th to the afternoon of the 12th November 1886.

India, February 19, 1887.

The services of Colonel W. S. Trevor, V.C., R.E., Secretary to the Government of India, in the Public Works Department, are replaced at the disposal of the Military Department, with effect from the 18th February, 1887, afternoon.

The Governor-General in Council is pleased to make the following appointments, with effect from the 19th February 1887 :—

Major-General H. F. Hancock, R.E., Chief Engineer, 1st class, Consulting Engineer for Railways, Bombay, Officiating Director-General of Railways and Deputy Secretary to the Government of India, Public Works Department, to be Secretary to the Government of India in the Public Works Department, *vice* Colonel W. S. Trevor, V.C., R.E.

Colonel R. C. B. Pemberton, R.E., Chief Engineer, 1st class, Consulting Engineer to the Government of India for Guaranteed Railways, Lucknow, to officiate as Director-General of Railways and Deputy Secretary to the Government of India, Public Works Department, *vice* Major-General H. F. Hancock, R.E.

Mr. C. Swappe, Executive Engineer, 1st grade, State Railways, whose services have been lent to the Indian Midland Railway Company, is granted furlough for two years, with effect from the 1st January 1887.

The services of Mr. J. D. Grant, Executive Engineer, 1st grade, sub. *pro tem.*, Madras, are placed temporarily at the disposal of the Chief Commissioner, Burmah, for the inspection of Irrigation works.

Major T. B. B. Savi, R.E., Executive Engineer, 1st grade, State Railways, is granted furlough on private affairs for one year and 228 days, with effect from such date in March 1887 as he may be permitted to avail himself of the same.

Railways.

Mr. F. D. Fowler, Executive Engineer, 4th grade, temporary rank, is granted furlough for twelve months, with the usual subsidiary leave, with effect from the 5th April 1887, or such subsequent date as he may be allowed to avail himself of the same.

Mr. D. F. Hogarth, Executive Engineer, 1st grade, is granted, furlough for eight months and twenty-seven days, with the usual subsidiary leave, with effect from 4th March 1887, or such subsequent date as he may be permitted to avail himself of the same.

Mr. A. Penny, Executive Engineer, 1st grade, is granted, furlough for twelve months with the usual subsidiary leave, with effect from 10th March 1887, or such subsequent date as he may be permitted to avail himself of the same.

Military Works.

The following promotions are made in the Engineer Establishment of the Military Works Department with effect from the dates specified :—

Lieutenant G. A. Stone, R.E., Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, sub. *pro tem.*, with effect from 6th July 1886.

Captain J. Kellie, R.E., Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 3rd September 1886.

Lieutenant G. Williams, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 10th September 1886.

Captain A. L. Mein, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, permanent rank, with effect from 1st October 1886.

Lieutenant G. A. Stone, R.E., Assistant Engineer, 1st grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade, permanent rank, with effect from 1st October, 1886.

Lieutenant E. D. Haggit, R.E., Assistant Engineer, 2nd grade, sub. *pro tem.* to be Assistant Engineer, 2nd grade, permanent rank, with effect from 1st October 1886.

Lieutenant J. M. Wade, R.E., Assistant Engineer, 2nd grade, passed the examination for promotion to 1st grade Assistant Engineer, laid down in Public Works Department Code, on the 13th January 1887.

Lieutenant G. Williams, R.E., Assistant Engineer, 1st grade, is appointed to officiate as Executive Engineer of the Sibi Division, Military Works, with effect from the afternoon of the 27th November 1886.

Lieutenant C. D. Learoyd, R.E., Assistant Engineer, 1st grade, passed the Departmental Standard Examination laid down in Public Works Department Code, on the 20th January, 1887.

Lieutenant W. G. R. Cordue, R.E., Assistant Engineer, 2nd grade, passed the colloquial examination in Hindustani laid down in Public Works Department Code, on the 7th February 1887.

Burmah, February 12, 1887.

With reference to *Burmah Gazette* Notification dated the 1st February 1887, Mr. J. C. Wyatt, Executive Engineer, 4th grade, sub. *pro tem.*, joined the Tharrawaddy division on the forenoon of the 4th idem.

Bengal, February 23, 1887.

Establishment—Railway.

Mr. R. S. J. Routh, Executive Engineer, 4th grade, temporary rank, Tirhoot State Railway, is granted nine months' furlough with the necessary sub. leave, with effect from the 11th March 1887, or such date as he may be permitted to avail himself of the same.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

February 17, 1887.

102 of 1885.—Absalom Backus, Jr., of the City of Detroit, County of Wayne, and State of Michigan, United States of America.—*For improvements in furnaces.*

148 of 1886.—Charles Arthur Turton, Tea Planter, of the Luckwah Tea Company, Limited, Upper Assam.—*For an improved machine for withering tea leaf.*

149 of 1886.—Charles Arthur Turton, Tea Planter, of the Luckwah Tea Company, Limited, Upper Assam.—*For improvements in the methods and machinery employed for withering tea leaf.*

184 of 1886.—Hugh Stevenson, Box Manufacturer, John Webb, Manufacturer, and Sam Hallam, Engineer, all of Manchester, in the County of Lancaster, England.—*For improvements in preparing, spinning, doubling, twisting and winding cotton and other fibre, and in the machinery therefor.*

186 of 1886.—Edward Phillips, of 84, Bishopsgate Street Within, in the City of London, Merchant. *For new or improved extinguishing apparatus for oil and spirit lamps.*

228 of 1886.—Benson Rathbone, Cotton Broker, of Exchange Buildings, Liverpool, in the County of Lancaster, England.—*For improvements in permanent-way of Railways and Tramways.*

SELECTED ABSTRACTS OF RECENT BRITISH SPECIFICATIONS.

"Improvements in Dynamo-Electric Machines."—No. 12,084. *Dr. John Hopkinson, F.R.S., of Westminster, England,* and *Edward Hopkinson, of Manchester, England, Engineer.* Application filed, 10th October 1885. Patent sealed, 14th December 1886.

This invention relates to that class of Dynamo-Electric Machines in which there is more than one magnetic field. In such machines as usually constructed separate electro magnet coils are provided for each field, but the object of Messrs. Hopkinson's arrangement is to reduce the number of electro-magnets, and form the fields as branches from the electro-magnets, and they claim by these means to obtain the needful magnetic field by a smaller expenditure of copper and of energy, than in the case of machines as ordinarily constructed. The drawings accompanying the specification show a disc armature, consisting of wooden bobbins on which the conductor is wound. These bobbins are carried in a disc or framework of wood, made in segments to prevent warping and bolted to a brass hub keyed on the shaft.

Only four electro-magnets are shewn, two on each side of the armature, but there are sixteen poles or magnetic fields of alternately different polarity on each side of the armature. These poles are arranged as follows. Cast iron plates are secured to each end of the soft iron cores of the electro-magnets; on the plates immediately next the armature there are eight short projecting pole pieces and on the outermost plates there are eight long pole pieces, their ends being in the same plane as the short poles. The course of the lines of magnetic force will be through the soft iron cores on, say, the left of the armature, to the outermost cast iron plate on that side, thence dividing through the long pole pieces and across the space in which the armature moves, to the short pole pieces on the inside right hand frame, thence through the soft iron cores on that side to the outermost cast-iron plate and back through the long pole pieces, from right to left, across the armature space to the left hand short pole pieces and the soft iron cores on that side, so completing the circuit.

The invention is generally applicable to multipolar machines, and is of course not confined to the exact arrangement described.

The "claim" is for a multipolar machine in which the number of electro-magnets is less than the number of magnetic fields.

Notices.

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CONTENTS.

Answers to Correspondents.

F. E. R.—Thanks—In our next.

INDIAN ENGINEERING.

SATURDAY, MARCH 5, 1887.

COLONEL FILGATE'S VIEWS ON THE P. W. D. REORGANIZATION.

THE Calcutta *Statesman* of the 27th February last contains the statement that Sir C. A. Elliott, Colonel Filgate, R.E., and Mr. Bliss, are about to take leave to England, in order to confer with the Secretary of State for India with regard to their labours on the Finance Committee. If this information is correct, it behoves the Civilian members of the Public Works Department to be on the alert. Some time ago the *Indian Daily News* drew attention to what then were, and still are believed to be, Colonel Filgate's views on the reorganization question, and the *Pioneer* followed suit in remarking upon the same. It must not be forgotten that the Finance Committee, who have practically no knowledge of the working of the Department, are disposed to agree with Colonel Filgate. It is generally believed, that that gentleman proposes the gradual elimination of the Civilian element, and that the Public Works Department be at some future day officered by Royal Engineers only, assisted by Civil Engineers, to be engaged, as required, on short agreements.

Now, this scheme has already been tried in part, and has failed egregiously; and it is a well-known fact, that very few competent members of the profession can be found in this country on an emergency, such as a war scare for example; and it is equally certain, that good men will not come out from England on short engagements; for the simple reason, that they lose touch of their home practice, and when their services are dispensed with—after, say, a five years' agreement—they will have to face a serious difficulty in finding suitable employment. It is self-evident, that a scheme of this kind must be a failure in the future, as it has already been in the past.

The first nail to be struck into the coffin of the Civil Engineers is the abolition of Cooper's Hill; and however opinions may differ as to the advisability of keeping up the College, there can be no dispute as to the fact, that it has turned out a large majority of good men, who have done excellent work in this country.

One can hardly believe, that the Finance Committee could be induced to consent to such absurd proposals as the above, especially when they are promulgated by a gentleman, whose whole experience of the Department he is going to operate upon so radically, has been gained in the Accounts Branch of the same. We are quite prepared to admit that there are many men of ability, and some of marked ability, among the Royal Engineer officers serving under the Government of India; but we cannot help feeling, that the system of training in their case is in many of its details a faulty one. Does it not stand to reason, that better Engineers must be turned out by the arduous theoretical and practical course adopted at Cooper's Hill—which cannot be less than four and may extend over five years, according to the success of

the candidate at the annual examination—than by the semi-military semi-engineering curriculum in vogue at Woolwich? It is in our opinion inevitable, that a good result cannot be obtained from such a course of training, especially when to it is added the manner in which Royal Engineers are pitchforked into the Department at any period of their service, irrespective of their knowledge of or predilection for any practical branch of the same, whether Railways, Irrigation, or General. The outcome of Colonel Filgate's proposals is, that the Department is to be officered in future by men, who unite the qualifications of Civilian-Soldiers and amateur Military-Engineers.

No better exemplification of this can be given (to the paying public) than a comparison of the construction of two frontier lines—the Bolan Pass and Sind-Pishin State Railways. The former has been worked almost entirely by Civil Engineers from the commencement, and has been carried out successfully and at a reasonable cost. The latter Railway, which was constructed under the management of a senior Royal Engineer, assisted by a staff of younger officers of the same Branch of the service, has cost nearly three times the estimate, and we are creditably informed that the waste of money and blundering have been something abnormal. This can only be put down to want of experience on construction, and want of that all-important quality—*bundobust.* Civil Engineers have now been sent to the Sind-Pishin to put matters straight, and a Railway officer of considerable experience, who went over the line not long ago, gave vent to a mournful wail to the effect, that he understood the reason of the Income Tax now, and put it down entirely to the inexperience of these young Royal Engineers, as he calculated roughly that on one division alone the waste of money in unnecessary plant, and mistakes made in carrying out the work, amounted to no less than half a million *sterling!*—A thought to make gods and men weep over in these hard times! All this points to the fact, that unless Royal Engineers are made to go in for a thorough theoretical and practical training, it is useless, and worse than useless, to attempt to re-organise the P. W. Department in the manner said to be proposed by the Finance Committee on the recommendation of Colonel Filgate.

CALCUTTA DRAINAGE.

ALL things considered, both as regards climatic and physical drawbacks, there are very few cities in the world that could compare favourably with Calcutta in the sanitary progress it has made even within the memory of men now living. It is considerably less than a hundred years that the present City of Palaces had retained the odious name of Golgotha, given to it by a Dutch traveller, and there was a special day set apart for thanksgiving—though marked also by carousals—in the month of November, when those who had outlived the pestilential summer met to congratulate one another in having obtained a new lease of existence. When the present century was yet in its teens an undertaker, having occasion to return to Europe, valued the good-will of his business in the Indian capital for the months of September and October at Rs. 20,000. Thanks, however, to a steady influx of Europeans and the growth of an independent public opinion, this undesirable state of affairs has been numbered with the institutions of the past, and Calcutta can now fairly boast of showing comparatively a clean bill of health. Although much has been done towards the attainment of this stage of progress, a great deal yet remains to be accomplished to produce more satisfactory results, and the presence of a HEALTH SOCIETY is an earnest of the good that is in store for the City. Of all the improvements that have been initiated within the last twenty-five years, the most prominent is the underground drainage, by which the surplus water of the town and all floatable filth is carried away in the first instance to a reservior at Tangra, then lifted on to a higher level by means of steam pumps, to ultimately find its way to the salt water lakes in the suburbs. Along with this, arrangements were made for flushing the conduits from the Hooghly, which led to the construction of 42 miles of brick sewers and 122 miles of pipe sewers. The execution of these works has cost the Municipality close upon a crore of rupees, and the annual cost of working it is estimated at Rs. 26,000. Although Dr. McLeod, the late Health Officer, pronounces the scheme "a great success, an immense gain alike to comfort and health," inasmuch as it has made the town drier and cleaner, he yet admits that "Improvements are no doubt possible in the direction of flushing and ventilating more particularly." We are therefore glad to observe that the Health Society has seriously taken the subject in hand, and by employing an agency independent of the Municipality, but not in opposition thereto, has arrived at the following results:—(1) That the drainage works of Calcutta, as designed by their author, have never been completed, inasmuch as the provisions which he designed for keeping the sewers clear of deposit have never been carried out and are still quite inadequate; (2) that the duty of keeping the sewers clear of deposit was at one time greatly neglected by the authorities to whom it was confided, the result being a most dangerous accumulation of fœtid deposit in almost all the drains; (3) that the house connections with drains were, in a large number of instances originally defective in structure or have been allowed to fall into disrepair, and that, wherever this is the case, the connection merely serves the purpose of conveying the poisonous sewer gas into the house; (4) that the existing provision for the ultimate disposal of the sewage of Calcutta is a ground for reasonable anxiety, and is likely at no distant date to prove a source of unhealthfulness to the City, and requires to be most carefully watched. In support of its position the Society lays it down as an undisputed axiom that "the entire sewer should be kept at all times thoroughly ventilated and wholly free from every form of deposit, whether originally of an innocuous nature or not." This is absolutely true, and no better evidence could be adduced than the actual condition of a large number of sewers, a year or two ago, in which sewage gas was allowed to generate and which proved a source of serious injury to the public health. The consequences

were, that drains into which choleraic matter had found its way, being in uninterrupted connection with the verandahs of houses naturally brought the seeds of the disease to the very door of the occupants. The Executive Committee of the Society even go a little further and affirm that several cases of cholera which have been brought to their notice may be distinctly traced to the defect in the trapping of the house connections with the sewers, or when the traps have been permitted to fall into disrepair. Referring to the Engineer's Administration Report for 1885, the Committee point out the fact that while there are 33,969 houses in connection with the sewers to be inspected annually, the number of inspectors employed for the purpose is only *six*. The result has been that only 5,347 premises were inspected during the year, and of these 1,070 were reported as having defective drainage; or, in other words, 20 per cent. of the houses were found to be defective, and the rate at which they were examined would lead to the inevitable conclusion that each of the premises would have the benefit of inspection but once in six years. The Health Society has proposed to itself a Herculean task of cleaning the Augean stable of Calcutta of its filth and refuse, and we wish it God-speed in its endeavours to perform a noble duty of improving the sanitary condition of the City. In our next issue we hope to take up the question of water-supply, which is much more important in connection with the subject.

PROPOSED CHANGES IN THE BENGAL P. W. D.—PROVINCIAL BRANCH.

THE officers serving in the General Branch of the Public Works Department in Bengal are all (we hear on very good authority) to receive a magnificent Jubilee gift on the 1st of April, or what may perhaps be rather described as a Christmas present based on 1st-of-April principles. It has been decided that the appointments of Local Inspector of Works, (corresponding to the present Divisional Superintendents of Road Cess Works,) are to be filled up *nolens volens* in every Commissionership in Bengal on the above date.

At first sight it would appear that the Department had much to be grateful for, but when we inform our readers that the new Local Inspectors will have to do Superintending Engineer's work on the pay of their grades as Executive Engineers, it will be readily understood that the gratitude is of a peculiar nature, and vents itself principally in language of a reprehensible type. Some of the present Divisional Superintendents hold larger charges, spend more money yearly, and have greater responsibilities than any Superintending Engineer in the regular Branch; they all have larger powers of sanction, and in spite of this, the order has gone forth, that these posts are to be considered Government appointments pure and simple in future, and that no extra pay is to be given for holding them. The present incumbents, who draw Rs. 1,100 a month (the pay of a III. Class Superintending Engineer), will all revert to their substantive pay and rank—Rs. 950 per mensem—and, in fact, one gentleman has already so reverted,— we mean Mr. Roberts, Local Inspector of Burdwan. We are informed that when these appointments were first instituted, the understanding was, that after three years' service on the pay of a 3rd class Superintending Engineer the incumbent was to draw the pay of a 2nd class; and similarly after three years' service in the 2nd class he was to be promoted to the 1st class. We know at any rate that one officer on being refused what he considered his promised and just promotion, threw up his appointment as Divisional Superintendent in disgust, and preferred to join the Railway Branch in Burmah as an Executive Engineer rather than stay on as Divisional Superintendent on higher pay, in a service in which he considered he had been unfairly treated. And now, it seems all the present Superintendents are—after all their service—to be promoted—backwards.

We ask our readers, would this be tolerated in the Covenanted Service? By way of example would a Joint Magistrate doing Collector's work, or a Collector doing Commissioner's, be content to draw his substantive pay? We think not. And this is not the worst. By returning to their positions as Executive Engineers, the present Divisional Superintendents will, *ipso facto*, cause to revert all the men in the regular Branch, who have received sub. *pro tem.* promotion on account of the absence of the former officers on foreign service. This means, that in every grade a certain number of men will have to go down a step in rank and pay. Truly they will have reason to remember the Jubilee year.

But the most comical part of the whole thing—if there can be a comical side to such a gross piece of injustice—is, that, in at any rate one case, the Local Inspector will be drawing less pay than his own District Engineers. In Patna several of the Engineers draw Rs.1,000 a month, and all, except one, are employed on salaries rising from Rs. 720 to Rs. 1,000 a month by instalments, so that in a few years the Local Inspector, who is in charge of seven districts, may hope to be in the happy position of drawing less pay than every one of his District Engineers, who are nevertheless subordinate to him!

We do not think we could add anything more than this to show the utter unreasonableness and injustice of the new scheme, for which we believe the Government of India are entirely responsible, and we trust it is not too late yet to improve upon it, or cancél it altogether. If carried out as at present proposed, it will lead to intense discontent and dissatisfaction throughout the whole Branch of the Department, as not one single grade will fail to be severely and seriously affected by the introduction of the new *régime*.

Major-General Alexander De Courcy Scott, retired list Royal Engineers, has been appointed by the Right Honourable Charles Thomson Ritchie, President of the Local Government Board, to the post of Examiner of the London Water Supply, vacant by the death of Colonel Sir Francis Bolton. The appointment is a snug one of £850 a year.

Railway communication between Melbourne and Adelaide was formally opened last month. When that between Sydney and Brisbane is opened, the chain will be complete, and the four capitals of Australia will be joined together by bars of iron. One road will lead the traveller without pause from Adelaide to Brisbane, through every variety of scenery and cultivation, and through the largest and busiest cities of our island continent.

Notes and Comments.

SAD BUT TRUE.—The S. P. Line is one a great deal could be written about, but it would be most unfavorable to anyone who had anything to do with it. From an Engineering point of view it is a disgrace. The curves are unnecessary and too sharp; tunnels run in wrong directions, bridges built without foundations and out of alignment, banks laid without reference to levels.

INDUSTRIES OF MYSORE.—The British Resident in reporting on the Administration of Bangalore for the year 1884-85 says that the only manufactory of any importance in that Civil and Military Station is the Woollen, Cotton, and Silk Mills. The concern is worked by a company with a capital of Rs. 400,000. About 85 persons are employed daily. During the past year 37,651lbs. of yarn, valued at Rs. 23,532, were turned out.

THE SHONE HYDRO-PNEUMATIC SYSTEM OF SEWAGE.—In connection with this subject, the Calcutta Public Health Society wish to urge the appointment of a committee of experts to examine the applicability of the modern systems of drainage, Shone's and others, to the suburbs. The subject was urged upon the Commissioners by no less an authority than Dr. Charles, and has never been adequately considered by competent judges.

MADRAS HARBOUR BOARD ESTABLISHMENT.—The cost of the administration of the Madras Port Trust appears to be unduly high. The payment of the Chairman, Secretary, and Trustees, and their office establishment costs Rs. 56,000 per annum, while the sum collected and administered is only about 3½ lakhs a year. The attention of the Board was called by Government to the expensiveness of the administration, and they have been requested to submit proposals for decreasing it.

AN ACKNOWLEDGMENT.—The Lieutenant-Governor, N.-W. P. and Oudh, again acknowledges the skill and ability with which the very important and profitable system of irrigation, the most extensive in India, continues to be administered by Colonel J. G. Forbes and the officers under him. Sir Alfred Lyall believes that no department of the public service has better or more capable officers, and he thoroughly recognises the value, to Government, of their unfailing exertions and their experienced management.

IRRIGATION WORKS, N.-W. P. AND OUDH, INTEREST CHARGES.—The total interest charges on productive and protective works to the end of the year 1885-86 amounted to Rs. 5,34,39,539, and the total net revenue realized to Rs. 5,39,17,884, leaving a clear surplus of Rs. 4,78,345. Excluding the Betwa Canal, as in former years, the surplus is Rs. 9,11,421, against Rs. 4,79,318 at the end of 1884-85. In 1880-81 the *debit* against canals was Rs. 84,08,747. This deficit has since annually been reduced, and it is satisfactory to note that the surplus is increasing.

N.-W. FRONTIER RAILWAY GUP.—The trial engine was safely run over the Chupper Rift bridge on the S. P. Line on the 16th ultimo. It is a pity the appearance of this fine work should be spoilt by a reverse curve on the bridge which it is believed could have been avoided. The platelaying is now being vigorously pushed on and a short time should see the completion of this line. It is reported that General Browne, R.E., only waits to see this done, when he will take his hard earned furlough. It is also rumoured that Mr. O'Callaghan will then take over the whole of the frontier lines as Engineer-in-Chief.

AN IMPORTANT RULING.—An application was lately made by a District Board for permission to raise a loan in the open market for the purpose of restoring and completing the construction of certain roads. The Government of India, however, doubt the expediency of permitting local boards to borrow money in order to meet charges which should be included in the nominal expenditure of the year, and consider that loans for such local subjects as the restoration and completion of roads are not admissible unless extraordinary circumstances can be brought forward in justification of such an unusual course.

EXTRAORDINARY PUBLIC WORKS, HONG-KONG.—The following are the approximate estimates of the larger works and buildings which the Colonial Government has in contemplation or which have been under consideration for Hong-Kong:—New Prison, $400,000; for Slaughter House, 50,000; Supreme Court and Offices, 75,000; Praya Junction, 438,000; Drainage of Happy Valley, 25,000; New Central Market, 150,000; New Western Market, 200,000; Police Buildings Extensions, 100,000; Gap Rock Light House, 90,000; Kellett's Bank Breakwater, 150,000; Filter Beds, Service Reservoir and Water-mains, 170,000; Sanitary Works, 600,000; total $2,448,000; equal to £408,000.

RHEA FIBRE.—Ramie or Rhea or China grass is a fibre which has been in use in India, China, and other tropical countries for a very long period, and, though the strongest fibre in nature, it had never come into anything like general use for the want of machinery that would make it marketable. Machinery has been invented lately to meet the want, and it is a question whether this fibre will not now enter into competition to some extent with silk and wool. Ramie is nearer in appearance to silk than any other fibre, and it is stronger than either wool or silk, it will mix with either and give strength to both. And what is of most importance, it can be produced cheaper than flax, hemp, or cotton.

DIFFERENCE OF OPINION.—The Hooghly bridge, which has cost half a million sterling, it was hoped, would enable the East Indian Railway Company "to convey the traffic from the North-West, not only to Howrah on the right bank of the river, but across the river to Calcutta, where they would have a station of their own." But Government "have reason to believe that the concession to one powerful company of a predominant influence over the approaches to the Port of Calcutta on both sides of the Hooghly would be very distasteful to the commercial community, and might prove prejudicial to their interests." The difficulty has, however, been arranged in a manner satisfactory to all the interests concerned.

PALMS AND LIGHTNING.—An explanation has been offered as to why palms act as lightning protectors:—Electricity always takes the less resisting medium, and air (especially dry air) being the worst conductor, it is natural that high trees and buildings will be chosen in its passage to earth; then, as water (especially acidulated water) is the best conductor, the fluid will choose the most sappy trees though they may not be the highest. As cocoanut trees are the first high points which the monsoon clouds meet on striking the coast line, it is natural that they should be the greatest sufferers, and as a single cocoanut tree is not sufficient to carry off the fluid, other trees, within a more or less extended radius, according to the quantity of the discharge, are also affected.

ALBERT HALL AND MUSEUM AT JAIPUR.—Sir Edward Bradford, in performing the opening ceremony of this

building, said:—"It is, I believe, a recognised principle, illustrated by the history of all ancient nations, that so long as art assumes pure and natural shapes, it continues to grow and flourish, but that any degeneracy of taste which favours the adoption of the unnatural must inevitably lead to deterioration and failure. This building, I am sure, may claim no little merit on this ground. Pure in detail and symmetrical as a whole, it may be looked on as the type of progress, and the lessons which will be learnt within its walls, will all tend to inculcate still further in the minds of an artistic audience that greatest of all objects in this direction, namely, the preservation of all that is best and purest in Indian Art."

THE VALUE OF IRRIGATION WORKS.—The success of our mission in this country will be measured, not so much by the records of our military reputation in Eastern fields, as by that higher glory which finds its expression in "monuments of lasting good." Among the grand movements which England has inaugurated, the system of irrigation is perhaps the most valuable. The Ganges Canal is the most wonderful public work of its kind in the world, and but for its saving influence, a great portion of North-Western India would be an arid waste. The Bari-Doab Canal waters the entire extent of country between the Ravi, the Beas, and the Sutlej. In the South the great volumes of water, which till now had rolled to the ocean, have been utilised, and extensive tracts of land irrigated or protected from famine.

MESSRS. THOMSON AND MYLNE'S SUGAR REFINING MACHINE.—The Director of Agriculture, Mysore, reports the following experiment:—In this case the rab used was only about a day's standing, as only 24 hours had been allowed for the syrup to crystallize. This was of the consistence of unground mortar when put in the centrifugal. Almost all the molasses drained away within five minutes of work to the astonishment of the professional manufacturers, who had been called to attend the process. About a seer-and-a-half of clear water was then poured into the sugar, as it was being worked upon in the machine; this removed the residue of the molasses, and after two or three minutes of further work the whole was perfectly dry for weighing. The rab used weighed 65 seers. This gave 31½ seers of rappoory sugar, the remainder having drained in molasses. This was pronounced to be a perfect success by the professional sugar refiners.

SURVEY OF WASTE LAND GRANTS BY PRIVATE SURVEYORS IN ASSAM.—The Chief Commissioner is prepared to recognise private surveys of waste land grants in Assam provided that the surveyor shall be a competent and reliable officer, whose name and qualifications shall be reported for approval, and that he will submit under his signature to the Deputy-Commissioner a full report of his survey operations for each grant surveyed, together with a map of each grant, for record in the Deputy-Commissioner's office, and such map shall, after the survey has been accepted, be signed by the Deputy-Commissioner, the owner of the grant, the Government surveyor or Sub-Deputy-Collector, and the private surveyor. Athough these are the ordinary conditions on which the Chief Commissioner is prepared to recognise private surveys, he does not bind himself to recognise such surveys in all cases where these conditions are satisfied; special cases may require special treatment.

THE MADRAS HARBOUR.—The Madras Government having received a telegram from the Secretary of State to the effect that the Harbour Board should not interfere with the authorized design of the Harbour, and on forwarding the same to the Trust for information, the latter declare that they never had the slightest intention of any direct "interference" as regards "the authorized design," though they have submitted their unanimous opinion as to the imperative necessity for a north-east entrance to the Harbour, in view to the same being transmitted by the local Government for the consideration of the Government of India and the Secretary of State in regular course. The Superintendent was thereon requested to forward, for the information of the Board and for transmission to Government, a copy of his telegram which appears to have elicited the message from the Secretary of State, as well as copies of any communications he may have since addressed to Mr. Parkes on the same subject. In the meanwhile, the Superintendent protests against the tone of the Board's recent resolution anent himself, but the Board record that they see no reason to reconsider their resolution.

THE EUPHRATES VALLEY RAILWAY.—Under the title of the *Advance of Russia*, Sir William Andrew calls attention to the need for a railway along the Euphrates Valley under manifest advantages. This railroad, for instance, would connect Alexandretta on the Syrian Coast with the head of the Persian Gulf, thereby shortening the distance between Britain and India 1,000 miles, and reducing the time for mails from 20 to 10 days. It would admit of India being held by a smaller European garrison, and of a large saving in the transport of troops. It would enable any enemy moving on the North-West frontier of India to be attacked in flank and rear, and ensure the practical security of India in combination with the Candahar line. It would be the means of bringing British power quickly to bear in the East, increase British influence in Europe, and give Britain the finest strategical position in the world. It would facilitate British protection of Asia Minor under the provisions of the Cyprus Convention, and give Persia ready access to the Mediterranean. It would finally be easily defensible. Its length is estimated at 920 miles and its cost under £6,000,000.

TELPHERAGE.—This system is not meant to compete with railways, whether steam or electric; but it is said to be, even already, more efficient than horses and carts. Over uneven or broken ground or in circumstances where good roads are an impossibility, it is, however, undoubtedly, the method of the future. The telpherage train consists of an electric locomotive and series of buckets, each of which hangs from a pair of wheels travelling along a strong steel line stretched from post to post, somewhat like a telegraph wire. The locomotive is situated in the centre of the train, and is driven by an attached electro-motor, which is in electrical connection with two of the train wheels, and through them with the steel line. These special wheels are on opposite sides of the locomotive, and must be so far apart as never to be on the same stretch of line, but always separated by one post. Now the line is not a single continuous one, but is broken up into segments by the post, alternate segments being in electric connection with one another and joined to one or other terminal of a machine for generating electric currents. The telpherage train thus acts as a necessary part of the electric circuit. The current must flow from the one special train wheel to the other through the electro-meter and so supply the driving power.

Current News.

THE Bombay Tramway Co. on the Jubilee day carried no fewer than 54,635 passengers.

SIR ALBERT CAPPEL has arrived in Calcutta and has taken over charge of his Department.

COLONEL JOHN HILLS, C.B., R.E., on return from field service, has been placed on general duty at Ahmednagar.

DR. FRITZ NOETLING has been appointed Palæontologist to the Geological Survey of India by her Majesty's Secretary of State for India.

THE pipes for the Ootacamund Water Scheme and part of the bridge for the Madras Railway at Beypore are long overdue at the latter port.

IT has been decided to abandon the Kyan-Nhyat-Sagadoung route to the Burma Ruby Mines, a much easier route having been found more to the south from Kyetpyin.

LIEUTENANT A. L. CARROLL, R.A., Assistant Superintendent at Dum-Dum, will be in charge of the Small Arms Ammunition Factory during Major Stone's absence in England.

THE Carew Company has secured the contract for the supply of sugar to the Bengal Commissariat for the next three years, and the balance sheet shows that it is in an unusually strong position.

THE Budget estimates of the Bombay Port Trust for the year 1887-88 show an estimated revenue of Rs. 41,01,700, and expenditure Rs. 39,43,400, leaving a surplus of Rs. 1,58,300.

WE regret to hear that news has been received of the death of Colonel G. C. DePrée, Surveyor-General of India at Jersey. Colonel Thuillier will naturally be confirmed in the appointment.

THE services of Mr. J. P. Dudgeon, Superior Revenue Establishment of State Railways, Locomotive Department, are, on his return from leave, placed at the disposal of the Chief Commissioner of Burma.

CAPTAIN C. B. HENDERSON, R.E., Executive Engineer, 2nd grade, acts as principal of the Madras College of Engineering during the absence of Captain Love, R.E., on leave, or until further orders.

MR. H. C. HILL, Conservator of Forests in the Punjab (officiating), leaves for Mandalay at once; his services having been transferred to Burma. Major Bayley will succeed him as Conservator, Punjab.

MR. LAWRENCE POTTER JOHNSON is appointed to the Superior Revenue Establishment of State Railways, Locomotive Department. Mr. Johnson's services are placed at the disposal of the Chief Commissioner of Burma.

THE Bombay Port Trustees have secured the contract for landing the plant and materials for the Indian Midland Railway. It is expected that the contract will increase the revenue at the Princes Dock by Rs. 75,000.

THE Lucknow Municipality have decided to place two pontoon bridges across the river Goomtee, one at the Martinière and the other at the Gao Ghaut, which will considerably facilitate locomotion throughout the city.

MESSRS. ROTHSCHILD having issued the prospectus of the Bengal-Nagpore Railway, with a capital of three millions sterling, bearing interest at the rate of four (4) per cent. per annum, the capital required for the Railway has been covered four times over.

THE report of the Directors of the Titaghur Paper Mills for the past half-year discloses the largest profit hitherto made, and is therefore very satisfactory. The average monthly outturn of paper for the half-year ended 31st December 1886 was 138 tons.

AFTER expending Rs. 1,400 in an experiment in digging an artesian well at Tuticorin, the result has been a complete failure, though Mr. Foote of the Geological Survey thought that trial borings might be made so as to arrive at a practical conclusion, and the Municipality have now decided to abandon further attempts.

A LONDON correspondent states that to one part of the Nagpur Railway scheme we are likely to hear serious objection, namely, the granting of a commission of 1 per cent. to the promoters. It is exceedingly difficult to understand, remarks the correspondent, how such a price, which means something like £30,000, should be necessary.

THE traffic receipts of the Calcutta Tramways for the week ended 12th February were Rs. 13,654 against Rs. 13,156 for the previous week and Rs. 9,700 for the same time last year. The improved receipts of this Company are most satisfactory and reflect great credit on the management of Mr. Maples, who is fast restoring this concern to the dividend stage.

THE Southern Mahratta Railway extension from Gubbi (near Tumkur) to Harrihur will, we learn, be put in progress this mouth. It appears Colonel Lindsay, R.E., the Engineer-in-Chief of the Southern Mahratta Railway, during his recent visit to Bangalore, decided the line shall pass by Davangeri instead of Shimoga. This seems to us a pity since through the latter tract of country immense, in fact all, the traffic now passes.

DURING his approaching visit to Behar His Excellency the Viceroy will, it is hoped, open the recently-constructed bridge over the river Gunduck connecting Tirhut and the North-Western Provinces by way of the Bengal and North-Western. The bridge is of eight spans of 250 feet, and connected with it is a viaduct half a mile long. The structure ranks, with the Benares and Jubilee bridges, among the greatest works of the kind in India.

SIR JOHN GORST, replying to a question in the House of Commons, said that Government had no intention of departing from their policy of constructing Railways in India either by Government or by Companies under a guarantee Any proposal, however, to dispense with a guarantee would be favourably received. Sir John Gorst added that Government had no intention at present of inviting offers for the construction of additional Railways under guarantee.

THE result of the repeated resolutions of the Supreme Government urging the extended employment, in this Presidency, of "Natives" (pure Asiatics) as engine men, has been that during the past year there were on the South Indian Railway no less than 21 drivers, 16 shunters, 164 cleaners, and 155 firemen engaged; while on the Madras Railway there were 9 drivers, 6 shunters, 329 firemen, the last named including 272 firemen who cannot speak English.

SIR BRADFORD LESLIE, Agent of the East India Railway, shortly proceeds on leave to England. He will probably sever his connection with the Company, in which case the selection of Mr. D. W. Campbell, C. I. E., for the Agency will be an excellent one and will be received with general satisfaction. Mr. Campbell has frequently acted as Agent, and as an opportunity will soon occur for a permanent appointment to the post, it is to be hoped that his claims will not be overlooked.

THE success with which the Bengal-Bombay Railway has been floated ought to convince the Government that the day for four per cent. guarantees is at an end, and that money can be had to any extent on much more moderate terms. A report is current in India that it is only part of the undertaking, as far as Bilaspur, that has been floated. We are in a position to state that there is no truth in this report, but that the present arrangement refers to the whole line, from Raipur to Sitarampur.

As a supplement to the Calcutta "Money Market Report" Messrs. Place, Siddons, and Gough have issued a large tabular statement showing the dividends paid by Joint Stock Companies during the five years from 1881 to 1885. The average dividends during the five years were as follows:—Banks 8·65 per cent., Coal Companies 12·76 per cent., Cotton Spinning Companies 6·46 per cent., Jute Spinning Companies 9·02 per cent., Pressing Companies 9·94 per cent., Tea Companies 4·45 per cent. The table will be very useful both to business men and investors.

THE Managing Agents of the Deoghur Mining Company circulate to their shareholders a report on the mine by Mr. F. R. Mallet, F.G.S., from which they observe:—"It will be seen that in his opinion it is almost useless to continue operations. Nevertheless, an indication of ore found in the 150 feet level is considered by the Company's manager worth following, and is accordingly being sunk there, and the leads will be followed until something is found or the indications die out. Should these explorations prove barren, they propose calling an extraordinary general meeting to give the shareholders an opportunity of considering the further operations of the Company."

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

THE EMPLOYMENT OF NATIVES AS GEOLOGISTS.

SIR,—The appointment of the Public Service Commission has sounded the tocsin for a warm discussion of one of the most intricate political problems of the day—a more extended employment of native agency in the administrative department under Government. But from the part public opinion has taken in the matter, there are grave reasons to apprehend that efficiency will be sacrificed to expedience and sentiment, two factors which, in my judgment, ought to be eliminated in an impartial investigation of the subject. While on the one hand justice demands that natives should have a fair and equitable share in the administration of the country, on the other hand it must not be forgotten that special cases must be judged on their own merits and in the light of surrounding circumstances. Keeping this principle in view, I am disposed to disagree with Mr. Medlicott's recent labored and querulous strictures on, and opposition to, the employment of natives in the Geological Survey Department. The Director apparently goes out of his way to tread on irrelevant ground. In trying to show the inaptitude of the native for original scientific work, he forgets that there is a general complaint throughout the land that both the system and the quality of education, which has been in vogue for the past half a century, has been barren of results in preparing young men to take a part in the battle of life. It is true we have crammed them with odds and ends of English literature, a few plays of Shakespeare, and some hazy, indistinct ideas of history in general; but beyond this very little has been achieved in the way of giving them a practical knowledge of nature as she ought to be studied. In a large majority of course the end and aim of all this preparation for a future career is to qualify the recipients of learning for a clerkship under Government, which is, in consequence, the acme of their aspirations. The subject is too hackneyed to require any comment. Under these circumstances is it to be wondered at that the country has not yet produced a Darwin, a Huxley, or a Tyndall. The very first element of success in any department of learning—self-help—is steadily and tho-

roughly eschewed in the course of training provided for the young, and in its place is substituted a meagre attempt at imitation. Can such a system, I ask, be capable of developing creative power, which may be lying dormant for centuries. Positive knowledge is doubtless a modern characteristic of Western civilization, and its practical results are conspicuous in the material which enlightened countries have attained. But can that knowledge be required without teaching and example being offered to those who are asked to profit by them? We sow thistles and expect to gather grapes! To say that the so-called educated classes in India have enjoyed the same opportunities and benefited by the same instruction as the leading minds in Europe or America, is a mere mockery, and could not enter into a serious discussion of this question. I emphatically deny that the word of knowledge has ever been preached in India. If Mr. Medlicott had said, instead, that learning by rote had been sedulously nurtured and carried out to the bitter end, I should feel inclined to agree with him in denouncing the practice. It is worse than useless to import—as Mr. Medlicott does, and I have read his Annual Report—into the controversy detached passages from Dr. Newman's "Grammar of Assent," and solitary phrases such as "'real' and 'natural' apprehension, as the characteristic difference between efficient and non-efficient faith, or rather between faith and profession," in support of his position. We must in the first place convince ourselves that there is anything like 'real apprehension' of a practical subject imparted to the alumni of our colleges, before we endorse Mr. Medlicott's opinion that the Bengali believes only in the Dictionary. VERITAS.

[The native gentleman in the Geological Survey who is the exciting cause of all these remarks—for and against—holds an English degree and other English qualifications.—ED., *I. E.*]

UNFAIR COMPETITION.

SIR,—I see in the *Pioneer* of the 19th February the following:—"The Punjab Government have given orders for the preparation of a survey for a line of Railway from Patiala to Batinda and Mr. W. Macdonald, Executive Engineer, has been deputed to start operations at once."

The tract of country between these places I find marked on the map as belonging entirely to the Maharajah of Patiala, and it cannot be an undertaking of the Indian Government. Is it right that with the distress existing among Indian Engineers at present for want of work that Government should continue filling outside appointments with their own men? There are many capable Engineers now wanting work or in temporary employ with Government who would have been only too glad to undertake the job. Kashmere, Hyderabad, Baroda, the Indian Midland, and the Southern Mahratta are a few more instances to the point, and I should like to know whether the Gwalior Government or the Bengal-Nagpore Railway are to be similarly supplied? It is hoped that Government will be petitioned that this injustice to us be stopped. We have been suffering long enough to see that unless we move ourselves in the matter nothing will be done. The Graduates of the Indian Colleges have made a start, and why should we not all join in a movement which concerns us all so vitally? OUTSIDER.

BOILER INSPECTORS.

SIR,—In your issue of the 19th instant, a correspondent, "L. C. E.," writing on "Boilers in Burdwan," suggests that the Boiler Inspector should have sound mechanical experience and knowledge and at the same time have a thorough technical and scientific training. If "L. C. E." had an idea of the duties of a Boiler Inspector and the salary he receive in India, he would not have made such a suggestion, as it is next to impossible to procure such a man for the salary offered; but it seems he has not, so I will enlighten him as to a few of the chief duties of a Boiler Inspector.

"L. C. E." must bear in mind that a Boiler Inspector's duty is "dirty" work, when conscientiously fulfilled. The Inspector must not be content with seeing the boiler pressed up to 10 or 20lbs. beyond its working pressure, but must examine every plate, rivet, stay and connection of the boiler, and especially those places where his experience teaches him to look out for signs of decay; this involves getting into every possible place in a boiler.

Now since "L. C. E." has an idea of the duties of a Boiler Inspector, I will go on to the question of salary. Is it possible, Mr. Editor, to get a Boiler Inspector with the attainments required by "L. C. E." on the salary usually given to Boiler Inspectors in this country? I am afraid not. Again, if salary is no consideration and such a man procured, we will soon find, that instead of getting a Boiler Inspector we have obtaind a "Boss," and the "Boss" of course will require assistants to do the "dirty" part of his work—for which he was specially engaged.

In respect to other matters, allow me to inform "L. C. E." that a competitive examination will soon distinguish a *Mechanic* from a *Mechanical Engineer*. Further, the *race* question is beside the issue, nor was there occasion to make a comparison between the training in a Calcutta workshop or *such a place as the Seebpore College* and European establishments. As for the Seebpore College, the passed men of the D Section, who have taken to the mechanical branch of the Profession, have given every satisfaction wherever employed, and I would suggest that the Government of Bengal, as an experiment, appoint a few of the passed students of the above section as apprentices under competent Boiler Inspectors, as a means of obtaining *future* Boiler Inspectors with a theoretical knowledge to back them at a minimum of cost. C. H.

Notes and Queries.

I. J. R. (SUKKUR) writes:—"H. I. G." can test his boiler in an efficient manner by the method he describes if the pump is in good order. Pumps with faulty lifts will sometimes refuse duty at slow speed.

I would recommend him to reduce the opening or aperture of the bottom valve, (that is the valve below the plunger,) to a minimum. As a temporary measure this will reduce the quantity of water formerly admitted, ensuring a more perfect action of the pump at a slow speed, and as a consequence also the labor required to move the fly-wheel by hand.

A lift of one-sixteenth of an inch would be ample for the bottom valve with a plunger up to four inches, when required for the purpose named.

"H. I. G." might write, if successful, for the information of other readers

II. C. H. (SEEBPORE) writes:—"H. I. G." should have tried the experiment himself, as it is a matter of 5 minutes to disconnect, and then let the Profession know the result. If he observes the following conditions, he will have an efficient test:—

1. The suction and delivery valves must be in good condition and have no leakage whatever, while all connections to the Engine must be sound.
2. The pump gland must be properly packed.
3. The manual labour employed through the medium of the fly wheel must give a pressure per square inch on the pump plunger, in excess of the pressure to which the boiler is required to be tested.

"H. I. G." should not be satisfied with the hydraulic test only, but must examine every part of the boiler minutely and carefully. It can then be said that the boiler has had a proper and efficient test.

"ALKUS" (ASSAM) asks:—"Will any of your readers enlighten me through the columns of your valuable paper with the discussion of the question (1) of proper bond used in brick walls in all its bearings, how the several layers of bricks are arranged at the corners with a minimum of closers and half-bricks, and (2) of the simplest, most fashionable and most convenient forms of twelve—and nine—inch cornices, bricks measuring in all cases 10″ × 5″ × 3″."

[ANS.:—Perhaps Booley's "Examples of Brick Bond"—Allahabad Government Press, 1876—might meet this wide requisition in part.]

Literary Notices.

THE ORIGIN OF MOUNTAIN RANGES CONSIDERED EXPERIMENTALLY, STRUCTURALLY, DYNAMICALLY, AND IN RELATION TO THEIR GEOLOGICAL HISTORY. *By T. Mellard Reade, C.E., F.G.S., F.R.I.B.A., &c.* London: Taylor & Francis. 1886.

The chief recommendation of this book to the Profession arises from the fact that the author is a Civil Engineer and Architect, who deals with his subject in a manner to be expected from one who has had much to do with the constructive arts. The subject matter, however, is debateable ground; but, nevertheless, there is much in the volume that cannot fail to prove of interest and value to our readers. The book is issued in demy 8vo. and illustrated with 34 single and 8 folding Plates, including numerous drawings of Mountain Structure and Scenery, by the Author, from Nature.

TRANSACTIONS OF THE SANITARY INSTITUTE OF GREAT BRITAIN. Vol. VII., 1885-86.

THIS volume is brimful of useful information in all departments of sanitary science and practice. The gigantic scale of the International Health Exhibition last year is a standing proof of the rapid progress and widespread interest of these subjects. The scheme for examinations is bearing good fruit, and local authorities at Home are commencing to recognize the value of the certificate granted at the examination, as a reliable guide in the selection of candidates for employment.

Among the papers that make up the contents we specially commend as being worthy of professional attention—Professor Corfield's "Water-Supply of Ancient Roman Cities;" Mr Lewis Angell's "Impediments to Sanitary Progress;" and Mr. J. Gordon's "Drainage of Continental Towns."

In America, a pine tree can be cut down in the morning and at six o'clock in the evening of the same day it will be manufactured into paper ready for the press, and the local paper will appear next morning printed on paper the material of which was a tree twenty-four hours before.

General Articles.

HOOGHLY BRIDGE.

THE result of the testing of the Hooghly Jubilee Bridge was favourable. On the Hooghly side the maximum deflection recorded was about 3¼ inches, or 0·27 on the level staff, the calculated probable deflection being four inches. The oscillation of the lower boom was inappreciable, that of the upper was 0·12. C. E.

THE LAHORE CATHEDRAL.

THIS magnificent building, of which we annex illustrations, was consecrated on the 25th January last.

The design is due to Mr. Oldred Scott, son of the late Sir Gilbert Scott, and the "style" is that commonly known as "Decorated Early English."

The building was estimated to cost 6½ lakhs of rupees; but as it was considered hardly fair to place the whole of this burden on one generation, General Pollard was asked to draw out a reduced estimate, which, while it did not lessen the size of the Cathedral, omitted, for a future day, the finishing of the towers, the whole of the interior groined roof, the tracings of the stone work, and other details of beauty.

It is this reduced estimate which has been used by Messrs. Burn and Co., of Calcutta, the Contractors, under the management of Mr. Attfield, C.E., their Agent.

It is only fair to mention that had the measures of General Pollard been strictly adopted, the entire appearance of the whole edifice would have been destroyed, but Messrs. Burn & Co. generously carried out the stone carving at their own expense, in concert with the original designs, although the revised estimate reduced the amount of outlay from Rs. 6½ to 3¼ lakhs, exclusive of foundations, on which Rs. 42,000 had previously been expended.

The whole of this vast work has been executed in a most satisfactory manner, reflecting great credit upon Messrs. Burn & Co., whose Agent, Mr. Attfield, throughout a period of 18 months, zealously devoted every energy and praiseworthy exertion to his gigantic and responsible task.

When Messrs. Burn and Co. had fulfilled the amount of their contract, and the Cathedral only required a further small expenditure, Mr. Ivens, C.E., who had most kindly given his services to the Committee in the measuring up of all past contract work, volunteered his assistance to complete the building—an offer which was most gratefully accepted.

The structure as it stands, including the furniture, has cost Rs. 4,08,000.

The furniture is nearly complete, the only exceptions being the Pulpit and the Reredos, both of which are in course of erection, and the Sanctuary tiling and lamps are on their way from England, and will be in position in the course of the next two months.

No provision has as yet been made for the peal of bells. This will cost a large sum; but it will probably be better to provide first a new organ before proceeding to what promises to be a very costly matter.

The pretty flêche which runs up between and above the Transept roofs will be undertaken immediately after the consecration of the Cathedral, and will prove to be a very beautiful external feature of the building.

Thus after many vicissitudes of fortune in financial matters, and after many crises in the building operations, the Punjab capital possesses a handsome and imposing Cathedral of which, even at this stage, it might well be proud.

It is satisfactory to learn that the internal arrangements are such that it is believed that in the hot weather the building will keep very cool, and that it may even be possible to dispense with punkhas, and to use only thermantidotes. Notwithstanding many prophecies to the contrary, there is plenty of light in the building during the day; and its acoustic properties are admirable. When a few remaining external features of the Cathedral are completed, and the flêche has been erected, it will be the greatest addition to the architecture of Lahore that has ever been made.

We subjoin the Original Estimate with a Memo of the Modifications made.

General Abstract of Probable Cost.

Quantity.	DETAIL.	Rate.	Amount.	Total.
			Rs.	Rs.
34,383 cubic feet ..	Concrete under foundations	@ 15/ per °/. ..	5,157	
9,835 ,, ,, ..	Ditto flooring ..	,, 15/ ,, ..	1,475	
77,544 ,, ,, ..	Kiln-burnt bricks and lime mortar masonry in foundation	,, 24/ ,, ..	18,611	
29,170 ,, ,, ..	Masonry in plinth, deducting stone-work ..	,, 28/ ,, ..	8,168	
223,790 ,, ,, ..	Do. superstructure, deducting stone-work ..	,, 38/ ,, ..	85,040	
11,247 ,, ,, ..	Stone-work, 1st class, or No. 1	,, 16/ per foot	1,79,952	
19,042 ,, ,, ..	Do. 2nd ,, or No. 2	,, 10/ ,, ..	1,90 420	
7,019 ,, ,, ..	Do. 3rd ,, or No. 3	,, 5/ ,, ..	35,095	
13,316 superficial feet	Stone flagging	,, 75/ per °/. ..	9,987	
13,165 cubic feet ..	Timber-work in roof trusses, &c.	,, 3/ per foot	39,495	
52 maunds ..	Iron-work (ornamental) ..	,, 40/ per md.	2,080	
2,385 superficial feet	Glazed ornamental windows, including frames ..	,, 3/ per foot	7,155	
380 ,, ,,	Doors, including frames ..	,, 2/ ,,	760	
25,962 ,, ,,	Slate roof covering ..	,, 50/ per °/. ..	12,981	
5 in No. ,,	Crosses	..	500	5,96,876
	Contingencies ..	,, 10/ per cent.	..	59,688
	Total ..	..	..	6,56,564
	Deduct— Probable value of old materials in existing foundation & plinth, &c.	—	—	6,564
	GRAND TOTAL ..	—	—	6,50,000

Major General Pollard's Note regarding the Reduction of the Estimated Cost of the Cathedral—Dated 10th August 1882.

In the Cathedral estimate the stone-work has been priced at three rates—

No. 1, at Rs. 16 per foot, includes all deeply cut and rich mouldings and foliated carving. It amounts to Rs. 1,42,352.

No. 2, at Rs. 10 per cubic foot, takes in all moulded work not included in No. 1. It amounts to Rs. 1,90,420.

No. 3, at Rs. 5, takes in all stone-work dressed to a fine face, but not moulded. It amounts to Rs. 35,095.

I propose for the present to omit all stone-work that can be introduced afterwards, supplying its place for the time being by wood or brick if temporary substitutes are requisite. Such stone as is built into the pillars or arches should be inserted during the building, but any elaborate carving can be dispensed with for the present. Acting on this view, we can, I think, fairly leave the caps of the pillars of the aisles, to be worked hereafter, pricing it and all such work at the rate of fair dressed stone.

Again, the merlons and tracery of the windows may be put in in either wood or neat brick-work plastered, and as such, priced, at say, Rs. 3 per foot. The groined ceiling may be omitted at present, the stone corbels from which the ribs spring being of course inserted in their proper place during construction.

Again, stone flagging need not be laid at once. Bricks laid flat over concrete will do for the time being at a third of the price.

The towers may be left unfinished until funds are forthcoming, and the windows may be ordinary glazed windows, at, say, Re. 1-8 a foot.

Taking all these deductions into account, and remembering that the foundation and plinth are practically completed, I think the Cathedral can be finished so far as to be fit for Divine service for a further expenditure of about 3¼ lakhs of rupees.

THE MADRAS HARBOUR:

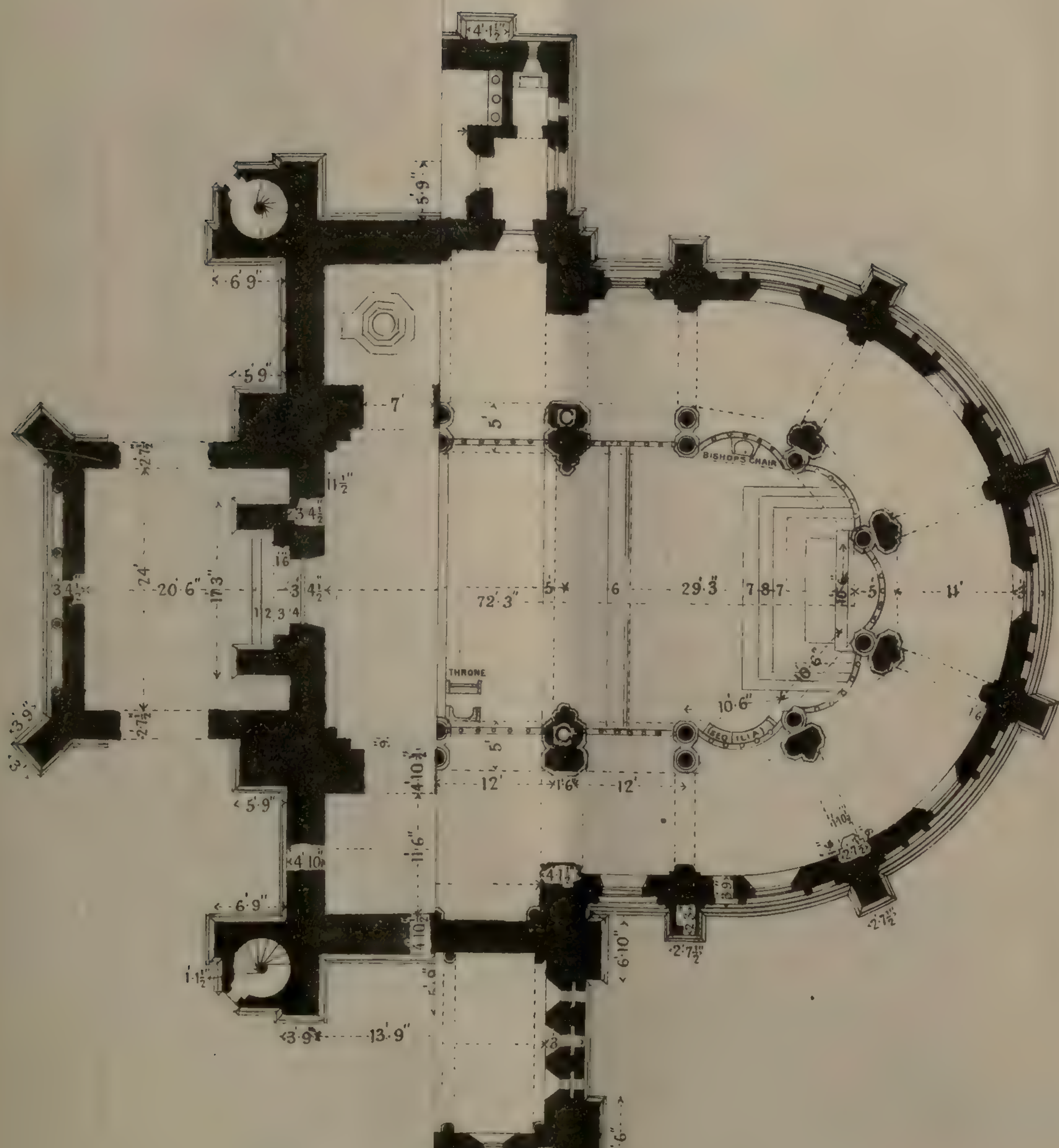
ITS CONSTRUCTION, DESTRUCTION, AND RECONSTRUCTION.

I.

THE reconstruction of the Madras Harbour is yet far from complete, but as its history up to the 25th September 1884, when the project for its reconstruction was sanctioned by the Secretary of State, has been published by the Government of India, in the Public Works Department, it seems not out of place to review it so far.

Never before, perhaps, has an engineering work been so much written about, and been so much the occasion of controversy. The volume before us,* which was published about a year ago, but which could not, of course, have been earlier noticed in INDIAN ENGINEERING, consists of 201 foolscap pages of small print, and 26 sheets of drawings, besides sketches interspersed in the text, and the letter-press comprises 71 separate reports

* Selections from the Records of the Government of India, Public Works Department, No. CCVI. Papers connected with the construction of the Madras Harbour Calcutta, 1885.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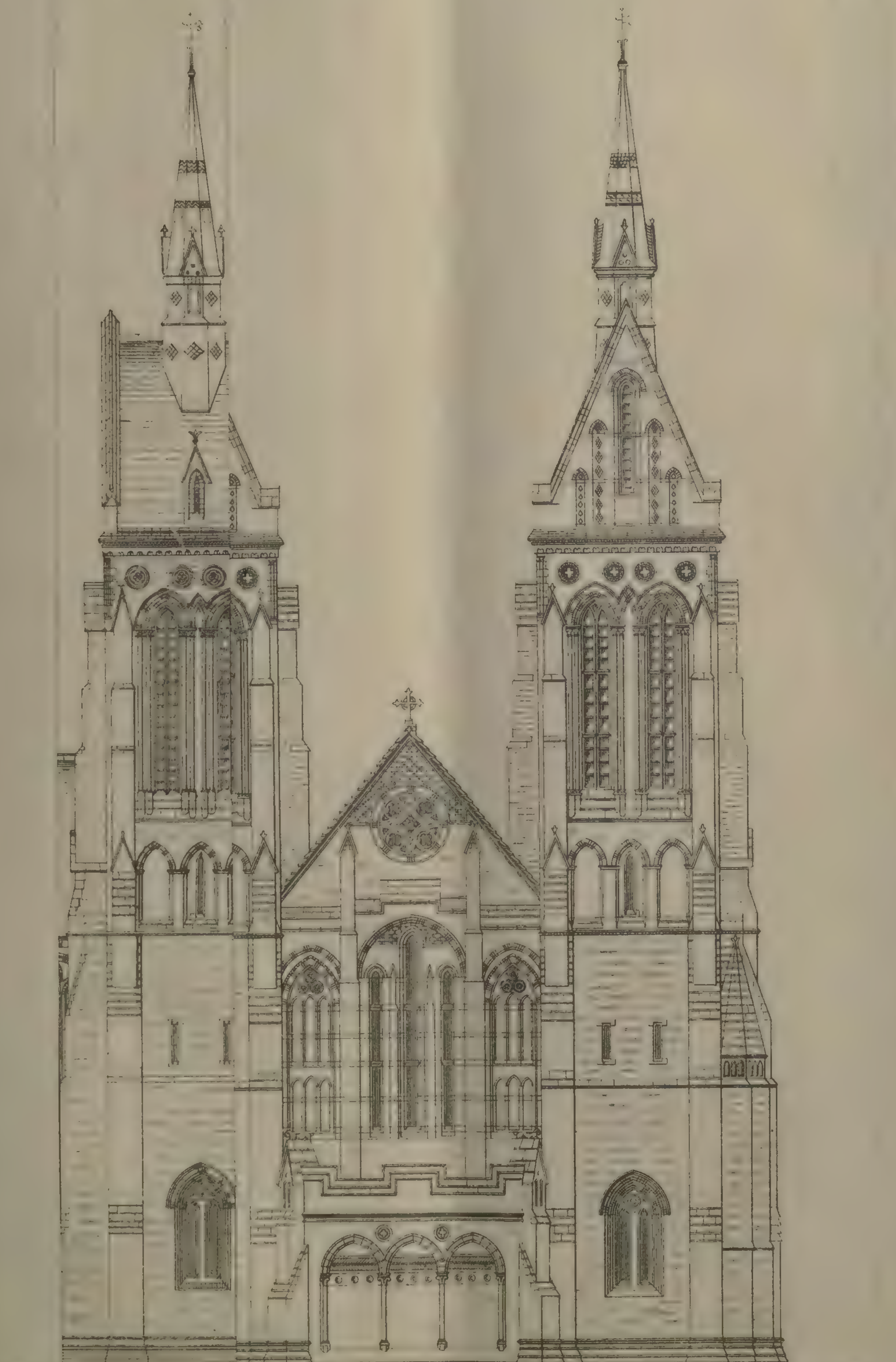

WEST ELEVATION.

or communications of one sort or another from and to Government, many of which include subsidiary documents. And not all the drawings submitted with these have been published. Running down the table of contents it will be found that the book contains the enquiries and opinions of no less than 33 Governments, Government officials, committees, public bodies, and engineering and nautical authorities, and many of these have had their say several times. High authority has said that—" in the multitude of Counsellors there is wisdom." Surely in this case, then, a wise decision ought to have been arrived at: but, on the other hand, it is known that "too many cooks spoil the broth," and we shall have to record a signal failure as the first result, and cannot yet predict ultimate success for the remedial measures that have been adopted.

Along the whole Coromandel Coast, the east border of the Madras Presidency, the only thing in the nature of a safe natural harbour is the area under the lea of the Armaghám Shoal, called "Blackwood's Harbour." This shoal lies parallel to the coast, 45 miles north of Madras; the nearest point is a mile from the land, and the average distance is four miles. The depth of water is variously stated as $1\frac{3}{4}$ and $2\frac{1}{4}$ fathoms, and the depth of water in the sheltered area is stated at 5, 6, and even 7 fathoms; but this very incertitude shows how little frequented the harbour is. And this is not to be wondered at, considering that the harbour fronts no place of trade; and though the shoal breaks the force of the sea to a considerable extent, yet the anchorage is not available as a harbour of refuge for ships lying in the exposed Madras Roads, both because of the distance, and because during the worst weather both the winds and the currents are against ships making for it. And, as one of the experts who have been consulted remarked,—"Madras cannot be shifted to the vicinity of the Armaghám Shoal, and ships will always come to the centre of business in preference to landing their cargos, however easily, on an inhospitable coast, 45 miles away, even if connected with the capital by a canal or a railway." While, therefore, it was admitted that "Blackwood's Harbour" might easily be made a safe and an excellent anchorage by the construction of a breakwater upon the shoal, at a cost of about a million sterling, none of the committees or experts consulted advocated that way of providing for the wants of the trade of Madras. And, there being no rival to Madras as a place of trade along the whole east coast of the Presidency, it was felt that an attempt must be made to construct a harbour there.

In 1868, the Chamber of Commerce of Madras had under consideration a proposal to form a breakwater about $1\frac{1}{2}$ miles long, in a depth of 6 or 7 fathoms of water, parallel to the shore of Madras, and they brought the subject to the notice of the local Government and urged the importance of constructing some such work, pointing out that if Madras was to do justice to the commerce which her growing net-work of roads and railways was laying open to her it was essential that her surf should, so far as possible, be done away with. And they believed that a breakwater would do this, and would also provide a harbour of refuge. They calculated that a charge of one rupee a ton, levied on the tonnage then frequenting Madras would yield a handsome return on the most liberal estimate of the cost of a breakwater, and they were quite sure no ship-owner would object to such a charge; and that the protection while loading and unloading and the safe anchorage afforded by the work, in lieu of the open roadstead, would attract the greater amount of shipping required by the increasing trade. The Chamber suggested that if the Government did not see their way to undertaking the enterprise themselves they should offer a 5 per cent. guarantee to a company to do so. The Governor of Madras, Lord Napier, warmly took up the idea, but advocated the construction of the breakwater for military as well as commercial reasons. He proposed that it should be a fortified work, as no other description of work could give any protection to Madras against the attacks of hostile cruisers. But he said the enterprise would be one of great magnitude and cost, and that many impediments and delays must be encountered and surmounted before the first cargo of stone could be deposited in the sea. "The prudent incredulity of superior authorities must be patiently and slowly vanquished." "The consent of scientific judgment, official sanction, and public support will at least be indispensable." As the question involved many considerations of a maritime, military, commercial and financial nature, as well as questions of engineering, Lord Napier thought it desirable that the design should not emanate directly and simply from the Department of Public Works, and on his recommendation the Madras Government, in August 1868, appointed a Committee, consisting of Colonel J. Carpendale, R.E., Colonel J. C. Anderson, R.E., Major J. H. M. Shaw-Stewart, R.E., Mr. H. D. E. Dalrymple (the Master Attendant of Madras), Mr. P. Macfadyen—representing the Chamber of Commerce, and Mr. B. Anderson, C. E., and Mr. R. B. Elwin—representing the Madras Railway Company, to report on the proposal. The Committee were instructed not to limit their enquiries and report to the preparation of plans, but to deal with the subject in all its bearings, including the agency by which the execution of the work might most properly be undertaken, and the provisions by which it might be made profitable as a financial investment. Colonel C. A. Orr, R.E., the Secretary to the Government of Madras, in the Public Works Department, at his own request was not put on the Committee, but at the first meeting laid before them a project for a breakwater prepared by Mr. deClosets, C.E., and himself.

The Committee's report is dated 16th January 1869, and they appear to have done their work most thoroughly. They not only availed themselves of all information found on record, but they also freely sought the opinions of a variety of gentlemen whom they considered qualified by profession and experience to aid them in forming a correct judgment on the several heads into which the subject naturally divided itself, and their opinions and proposals were submitted to Government *in extenso* in an appendix to the report. As this appendix has not been published among the papers under review, we can only imperfectly gather the nature of the various projects from the allusions made to them in the body of the report.

The authorities thus consulted, or who submitted proposals to the Committee were, besides Colonel Orr, Mr. R. F. Chisholm, C.E., who advocated the construction of a breakwater formed of a combination of stone and timber framework, on the principle adopted at Blythe, on the coast of Northumberland. This design was rejected by the Committee on account of the great difficulty of constructing such a fabric in the heavy sea usual at Madras, and the certainty of the destruction of the timber by the *Teredo navalis.*

Mr. J. P. Doyle, C.E., appears to have submitted a design for a breakwater in which screw piles were a prominent feature, but this was rejected on account of the expense of screwing piles in such a depth of water as 7 fathoms, and the liability of the work to injury by the sea and by vessels fouling it in bad weather.

Mr. W. Fraser, C.E., advocated the formation of a closed harbour, thinking the formation of groynes along the beach, north and south of the harbour would sufficiently prevent it from being silted up by the sand and silt in motion along the coast, which he thought very small. The Committee rejected this design as altogether unsuited to the locality, finding strong reason to conclude from the result produced by small groynes already constructed at Madras that the beach could be indefinitely extended seawards by such a process, or by the walls of a closed harbour, and that the sand would always get round them and fill up the harbour.

Mr. Rymer-Jones' design differed from Mr. Fraser's in providing a combination of open screw pile work next the shore and solid masonry piers beyond instead of solid piers throughout, but this also was rejected as the Committee thought the open work at the shore ends

of the piers would offer sufficient obstruction to the littoral currents to divert them seawards along the solid piers, and that the final shoaling up of the bed of the sea to the outer end of the proposed harbour, followed by the shoaling of the harbour itself, would be the inevitable result. Mr. Jones' piers, moreover, were to be of course of masonry, and the expense of this would be prohibitory.

Mr. George Wells, C.E., and Captain Heathorn appear to have jointly submitted a design similar to that of Mr. Jones, for it was rejected for reasons similar to those just mentioned. Mr. Wells was a screw-pile man, and of course thought there was "nothing like leather;" but we imagine that he afterwards saw cause to estimate the difficulty of screwing down heavy piles in a seaway at nearer its true value.

Mr. Samual Perkes, C.E., was also in favor of a closed harbour, but his proposal met with the fate of other similar ones.

A CAPITAL FOR INDIA.

RECENTLY at a meeting of the East India Association a paper on the choice of a capital was read by Sir George Campbell. This is the gentleman who will be famous in all history for slaying a living language. "I decree," he said, "the abolition of Urdu." In the paper now under review Sir George Campbell begins by pointing out that Calcutta would not now be selected as a suitable site for a capital. Let us amplify this statement—as a microscope magnifies an object to determine its true proportions. Let us suppose that a nation like an individual could die in the space of five minutes. Let it bequeath its possessions to some other nation or nations, and let there be an International Court of Probate to see that everything is *en règle*. Let A be the people that held India, and let A on its death-bed bequeath the country to B. Let the country as now be fitted up with railways and telegraph lines and let B proceed—irrespective of such vested interests as those of landlords or large confectioners—to choose a suitable capital. Then the place selected would not be Calcutta. So says Sir George Campbell—*minus* the illustrations—and we humbly beg to concur.

Sir George Campbell's next point may be put somewhat as follows :—A capital once duly planted can only be uprooted with difficulty. Indeed, the difficulty is much greater than to abolish a living speech which may not have among its adherents more than a few score millions. Therefore, if it were now for the first time a question of formal removal, Calcutta might send down to her wide-spreading roots the message "hold on" and might carry on her trunk a defiant large lettered notice—"*J'y suis et J'y reste*." But Calcutta—so hints Sir George—has in effect already been uplifted and after a sort of unstable fashion is propped on a hill called Simla. Here, however, our feeble reasoning power toils after his argument in vain. But not for bewildering metaphor is he responsible—he is always and on principle prosaic. If we vary the metaphor—to adapt it to the regulation—Qui-hy—we may say that Sir George gives us to understand that Calcutta has ceased to be the capital—that Simla now holds the officiating appointment—but that this is not a "strong" appointment—and that some other latitude and longitude should get the appointment *pucca*. After a careful study of this conundrum—viewed as coloured with metaphor or viewed uncoloured in prose—we at last discover that the Governor-General is supposed to carry the capital—as a bachelor is said to carry his family—under his hat.

"The evils of a peripatetic system of Government are very great." This is Sir George's own formula. Even the most prosaic speaker must occasionally appear to be lapsing into metaphor. For language—as Oliver Wendell Holmes finely remarks—is only "fossil poetry." When Dean Trench undertakes to improve upon this by saying that language is also fossil architecture or this or that fossil 'ology—he simply shows that he had failed to grasp the splendid generality of Holmes. Now let us *re* the above formula of Sir George Campbell draw one useful distinction.

A few years ago when census papers were sent round to be filled up by Anglo-Indians and by others, there came one of these inquisitive sheets to A. B., a young competition-wallah. A. B. had—as a wine merchant might put it—recently been landed ex S. S. *Britannia*. "What manner of man may you be ?" asks this census paper. "It may be you are a member of the Government, or possibly a judge or a barrister, or perchance you live on your ancestral estate or perhaps you find it necessary to live otherwise—in any case kindly explain." When A. B. had given his best attention to these classifications of humanity he concluded that in all probability he was a member of the Government. Now, though this may be highly amusing to "all good fellows whose beards are grey," yet if we examine into the lately much agitated question whether the Government should as heretofore make constant migrations to Simla, we discover that to many honest folk "Government" means the Viceregal Council *plus* the heads of departments—though not their wives or piccaninnies—*plus* any other man who is a C. S. and has much bureaucratic influence.

But we will venture to promulgate the heresy that heads of departments form no part of the Government. Nor is the wielding of bureaucratic influence a "Note' of belonging to the Government. The Bengalee office baboo has bureaucratic influence—a chuprassee may tremble at his frown. "The evils of a peripatetic system of Government are very great." This is the formula of a man who has had extensive official experience. Once he was chosen—by the Duke of Argyll—to rule over a land, which measured by square miles, or measured by population, would look a large country in Europe. But yet his formula does not appear to embody all the necessities of the case. We venture, therefore, to move a slight amendment. Let the words commencing with "the" and ending with "great" be struck out. In their place let the following be substituted. "It is most desirable in the interests of this vast tract of country, which holds a great variety of peoples—differing notably in national characteristics—that the Governor-General, accompanied by his chief advisers, should make himself conversant—by frequent travels—with each particular province and its people."

But how about the heads of departments ? Is there any conceivable reason why they should add themselves on to the rear ? The real Government is in size like the head of a comet. Let it continue to perambulate the vast spaces of India. But let that far reaching sweep of tail be docked just at the root.

Finally, if in any country it be desirable to choose a capital by a formal deliberate choice it does not seem necessary that the situation should be central. There is perhaps no animal whose brain is centrically located—say next door to the stomach. It is usual to place the brains at some outlying extremity. There are telegraphic wires to the hands or the feet or other local centres. In India we are provided with a telegraph system distributed with great completeness. Thus if the analogy holds between the body individual and the body politic—and we think that here it does hold—it would follow that an outskirt site like that of Calcutta or Bombay may be not less fitted for the purposes of a capital than Jubbulpore or Allahabad.

THE telegraph line connecting Bangkok with Burmah has been working satisfactorily in spite of the difficult country through which it had to be taken. This line will shortly be duplicated by another, crossing the hills between Siam and Burmah at Myawadi, to the north of the present line. Another line is in course of construction, passing from the capitals down the east side of the coast of the gulf. The line connecting Bangkok with Saigon has for some time past been out of order and useless, as the insurgents in Cambodia pull down the wires and cut them up for bullets. The line running along the river to Chiengmai will, it is said, be of considerable benefit to the teak trade.

RANGOON DRAINAGE PROJECT.

(*Concluded from page* 111.)

Estimated cost of ordinary Sewerage Works.				
44,420 yards 6″ C. I. gravitating sewers 6 feet deep				
2,565 „ 5″ C. I. sealed sewer-main				
640 „ 6″ „				
490 „ 7″ C. I. sealed sewer-main.				
640 „ 8″ „				
1,110 „ 9″ „				
460 „ 10″ „				
160 „ 12″ „				
320 „ 14″ „				
680 „ 15″ „				
490 „ 16″ „				
3,500 „ 18″ „				
570 „ 7″ C. I. air-mains				
320 „ 6″ „				
1,110 „ 5″ „				
1,300 „ 4″ „				
3,800 „ 3″ „				
Cast-iron connections and special castings				
50 flush tanks of cast-iron				
25 Ejector Stations in C. I. tubbing, 50 four-feet spherical Shones				
Pneumatic Ejectors and connections				
25 man-holes in brickwork at Ejector Stations				
400 man-holes on gravitating sewers, 2 air compressing engines 24¼ inches diameter, air cylinders, boilers, air receivers, and connections fixed ready for work, engine-house, foundations, and necessary buildings	...	£114,673	5	0
Estimated cost of Sulliage and Night-Soil Depôts.				
150 night-soil depôts as per drawings				
6,000 double sulliage depôts—25 blocks to be treated, each block having 240 depôts		£55,673	0	0
Estimated cost of Supplementary High-Pressure Water Supply.				
1,700 yards 7 inch C. I. air-mains				
700 yards 27 inch C. I. water-mains				
2 27-inch sluice valves at Filter beds				
Special castings connecting pipes				
1 air-compressing engine 24¼-inch air cylinder, boiler, air receiver, and connections fixed ready for work, engine-house, foundations, and all necessary buildings				
Ejector Station and 3 Shones, Pneumatic Ejectors, each 2,000 gallons	...	£16,689	0	0
		£187,035	5	0

THE LIVING EARTH;

A Lecture delivered at Dacca,

By A. Ewbank.

At no time in the past history of man can this earth on which he lived have been other than an object of his deepest interest. In those early days of man's existence, when his thoughts hardly ranged beyond the imperious necessities of his physical life, earth was his thoughtful mother. In her lap his life was cradled. Before he had learned to till the field and to store up harvest for the future she yielded food in profusion ever ready to his lips. Dense and mighty grew her forests yielding him a welcome shelter from the rays of the noonday sun. In their shady recesses springs of purest water rose unhidden, where he might slake his thirst. And when his short life was ended, he slept again in her bosom and her flowers waved over his grave.

Century after century passed away, moving in slow procession. Out in the heavens above him he saw little token of change, a vast, a silent order stretching from star to star. But the earth beneath grew restless—restless with human life. No longer content like a happy child to lie on its mother's bosom, dreaming a careless existence; strange new thoughts were stirring within him—tokens of the destiny before him. Inner questionings troubled his soul—the questions of whence? and whither?

Shaken by human passions and human fears he saw in nature the troubled reflection of his own inner life. Earth seemed no longer but a kindly mother, tending him from his cradle to his grave, and then forgetting and forgotten. His growing mind questioned and denied the utter silence of the tomb. Surely beyond the narrow tract of earth, where he first grew into consciousness, there awaits him yet another existence in some far distant land. Slowly he grew in wisdom and in strength. New generations of men ever journeying onwards filled new spaces of the world. Thus heaven, that ever retreated before them, finding no country that remained unsought at last rose into the skies.

In a life like that of man, where good ever struggles with evil, the conceptions of heaven were hardly complete without a vision of hell. Therefore, in earth also was hidden a place of torment. Filling some dark inner sulphurous space, that threw up from time to time its lurid flames far into the midnight sky, it remained the longer by reason of its terrors preserved from his questioning gaze. Still in the popular creed of many a modern people everlasting flames lick the quivering flesh— infinite tortures for finite crimes committed by frail humanity.

Had man for ever lived his life in some quiet valley where neither storm nor earthquake brought terror to his soul—where a bountiful nature supplied his wants with no labour of his own—no putting forth of strong human energies, no hardships, no disappointment, no care—then might he have dreamed of his happy heaven, but never shuddered at a hell. Possibly so it might have been, for man is a child of nature and his mind, in its conflicts of good and evil, of hope and fear, of rapture and anguish, is but too faithful a picture of the varying aspects of the earth. Nature, however, has been careful not always to spoil her child. If at times her face is radiant with smiles and she showers her gifts upon him, at others he is left to struggle in the storm—to be wasted with pestilence and famine. He sails, as it were, on an ocean that sometimes may gently be heaving like the pulses of a sleeping breast. Anon its slumbering strength is wakened into tempest. His tiny bark is lifted for a moment upward to the darkened sky. It plunges downward through the blinding foam and the wandering waters are its grave.

Thus changeful seemed the face of nature, thus wantonly capricious—to-day watchfully tender—to-morrow carelessly cruel. But these privations proved man's ultimate strength—these dangers were his salvation. He learned to grapple with his evil fate—to wrest his blessings from the reluctant hand of nature. As man grew more thoughtful and more resolute, nature seemed less unkind; at last she gave herself to him as a bride to a strong man. His thoughts no longer narrowed to the compass of this tiny world have broadened to hold the universe. Compared with the stellar spaces which modern science has measured, earth may dwindle to a speck. Nevertheless her value is not lessened. The richness of her life, the complexity and subtlety of her relations to man, are subjects of undying interest. Let us remember that however we may feed our intellects and imaginations with the vastness of other worlds; still to this earth our energies must ever be confined; here lie all our sorrows and our joys—our past and our children's future.

Let us now deal in detail with the subject to which your attention is invited—The Living Earth. We need not lose ourselves in metaphysical discussion as to the definition of life. Let us use no language but such as possesses a meaning and is easy withal to understand. Take a common stone, such as lies in the street outside. Take it as a symbol of that which has no life. Year by year and century after century it remains perceptibly unchanged. This is life—to change. Compare also its character with that of a tree or flower. The flower is composed of parts which are unlike and each has its special function. This is life to have special parts and functions—let us say to have organs. Thus we say that the flower is organised while the stone is inorganised.

And now let us come at once to the study of the living earth. Let us commence with the continent of Asia. Have you ever recognised the massive beauty of its shape? It is among continents, what the elephant is among land animals, the largest of them all. Observe that it throws out to the south three promontories or peninsulas, Arabia, India, and the parts near Burma and Siam. Perhaps you consider that this arrangement is merely accidental. If so, glance at Europe. Arabia in Asia is the counterpart of Spain in Europe—each continent thus ending in a simple massive promontory. To the east of Arabia we find India—to the east of Spain lies Italy. These peninsulas are more delicate in outline than the countries of Spain and Arabia. At the apex of India we see an island—there is one at the apex of Italy. After Europe shows us the massive peninsula of Spain and the more delicate outline of Italy, she breaks at her south-eastern extremity into a highly indented coast line and a multitude of beautiful islands. Asia in like manner surrounds her most indented peninsula with islands that stretch to Australia.

Europe connects herself by a thread of land with the massive continent of Africa. Asia in like manner had once a strip of land that joined her to Australia. Are these resemblances merely accidental? The world contains six continents which are coupled two by two. North America is joined to South America by an isthmus. Europe is connected with Africa by an isthmus. Asia and Australia have been so likewise. Asia is the home of the oldest civilisation, Australia of the lowest savage. Europe is the dwelling place of art and science; Africa is still uncultured. North America is filled with energetic and powerful peoples; South America nourishes wandering tribes in the silence of primeval forests.

Again, let us compare Europe on the one hand with North America on the other. Europe commences with a promontory trending to the south—the countries of Norway and Sweden. America replies to this feature with the massive promontory of Greenland. The west coast of Europe is deeply indented and the east coast of America corresponds thereto like a man and his image in a mirror. Europe shows the Baltic Sea, which is almost surrounded by land. America gives answer with Hudson's Bay, which has almost the character of a lake. Lastly, to the inland seas, the Mediterranean corresponds to the Gulf of Mexico. Thus in complexity of form—in her contrasts and correspondences—the earth is richly endowed.

Life, we said, consists in these and in similar characteristics. It may, however, with reason be objected that these definitions are not sufficient. The great characteristic of life is movement, action, energy. Thus no doubt reasoned men of old when they felt there was life in the earth. As they watched some mountain breathing flame and pouring from its summit a river of molten lava, they knew themselves in the presence of mightier forces even than the storms that rage through heaven or the waves that lash the shore. Let us examine in closer detail one of these grand manifestations. In the year 1863 occurred an eruption of Mount Etna. For two years the mountain was in action. Masses of burning rock were hurled into the air to the height of one mile. A river of red hot stone overflowed the crater and pouring down the mountain slope reached a distance of six miles. In its progress a forest of one hundred thousand trees was carried away by its strength. The broken trunks borne away on the tide burst into flame as they floated along—a spectacle of weird splendour.

And yet this terrible outbreak was not exceptional in its grandeur. During the last two thousand years the destructive overflows of this one mountain have been witnessed seventy times. Nor is Mount Etna unsurpassed for the grandeur of such displays. Imagine yourself in the middle of the vast Pacific Ocean having Asia on your left and the Americas on your right. Starting from the isles contiguous to Australia—passing upwards along the east coast of Asia as far as Kamschatka—crossing then over to North America—and passing downwards along those mountain ranges that reach to Cape Horn—we have a long series of volcanoes which are still in action. These, which are about two hundred in number, are called the circle of fire.

Need we wonder that these fierce volcanoes have been the dwelling places of such merciless gods as those to whom in my former lecture your attention was directed. Owing to the beauty of the Island of Java and to the fury of its volcanoes it has been dedicated to Shiva, the God of Destruction. In the very craters of the burning mountains his worshippers built their shrines. In New Zealand the ever smoking orifice of Tongariro is considered the only suitable place to receive the remains of a chief. When his body has been cast into that abyss the hero will join the gods. About three centuries ago, Christianity found its way into the villages of Japan. Then there came a fierce persecution. Living men and living women were hurled by hundreds into the crater of The Unsen, one of their most active volcanoes. The wrath of the Older Gods had been awakened by the spread of the new faith. By the sacrifices offered their anger was appeased and the volcanoes slept for a while. In like manner Christian priests have recognised in the flaming mountains of the New World the energies of infernal demons. The monks of Nicaragua—so runs the legend—climbed the terrible mountain of Momotombo to quiet it with their spells. But they never again came down to the plains, the monster had swallowed them up.

If now we turn from flaming mountains to those that lift their peaks to heaven through a raiment of eternal snow, we feel ourselves in the presence of a different strength—the presence of strength in repose. With these may be classed all lofty mountains, although it may be that in summer heats their white mantles drop from their shoulders. These mountains also have been reverenced by man and chosen for the dwellings of the Gods. India has its sacred mountains and so has the country of China. To the Armenians Mount Ararat is holy. On one of the rocks of the Caucasus Prometheus was chained for stealing the fire from heaven. The Titans dwelt in Etna and Jupiter on Olympus. What marvel then if tribes less cultured have been proud to behold in some lofty mountains their father or their God?

These grand peaks seem indeed to have been watching over the whole life of humanity. If there is one impression more than another which they give to the mind it is that of the unchanging—the eternal. And yet—the everlasting hills are slowly fading from the sight, although the compass of no human life may suffice to watch the change. As from the mountains that flame with fire streams of molten lava pour slowly down, so from some of these mountains descend rivers of ice with silent but resistless force. The clouds that discharge their burdens on the mountains are the sources of these rivers. Alternately melting and freezing, as the day changes to night or the summer to winter, they travel slowly downwards. Massive rocks enveloped in the solid stream are torn from their stony bed and dragged to the plains below. To these we must add what is carried down by mountain streams or hurried by mountain torrents. Thus it has been estimated that the various streams which descend from the Alps and the Apennines carry away between them every year such a quantity of rock and soil as would make a mass one mile long, one mile wide and one mile high. Thus in the course of ages even the immense structure of a mountain is little by little removed. Indeed, by day and by night the rivers are ever engaged upon their appointed task to bury our mountains in the depths of the sea.

When we consider first the splendour of a volcanic eruption, which may take place twice in a century, and secondly the never-ceasing energies of rivers of ice and rivers of water, which of these two agencies shall we pronounce the mightier? To my mind the ever-moving water is the more marvellous of the two. If then we attribute life to the earth as we gaze awe-struck at a burning mountain, how much rather shall we call her the

living earth when we remember those vast but silent changes that are never for a moment stayed ?

(To be continued.)

GRASS COVERING FOR ROADS.

The question of providing a suitable hard surface for traffic on roads in black and alluvial soils as also sandy plains, is often a matter of some difficulty in a part of the country where stone is not procurable at a reasonable cost.

In such cases the materials for road surface in common use are, according to the convenience of each locality, moorum, yellow and red earth, coarse sand and gravel, lime kunker and broken brick.

There are, however, some districts where none of the above materials are available. The country in the valley of Indus is a case in point. Here munificent nature has, however, supplied a material which not only serves the purpose of surface covering to roads, but is brought into various other uses by the skill of man. This material is reed grass, which grows abundantly in low ground subject to inundation and on the banks of some canals. Chicks for doors and roof and ceiling tatties are largely made of this grass, and a variety of it called "sucha" is worked into strings and upper tatties for roofs called "tuahs" and even baskets. It is difficult to conceive of any other material which can advantageously supply its place.

The inconveniences of roads in Sind when unprovided with any surface are :—(1) Dustiness and heaviness, (2) unevenness owing to ruts and hollows easily formed, (3) slipperiness after a slight shower of rain, especially in soil affected by salt called "kalar." These defects are to a great extent remedied, if not entirely removed, by a grass surface.

125 cart loads of reed grass, each measuring about 150 c.t., are sufficient to cover a mile of road for a width of 16 feet. The cost per mile is about Rs. 100 with an average lead of 1¼ miles for grass. With a smaller width or material close at hand the cost can be brought down to about Rs. 40 per mile. A second partial layer containing half the former quantity will preserve the surface throughout the year.

It is remarkable that fires on these roads are of very rare occurrence, and when they occur they are easily checked.

G. R. T.

NOTES FROM HOME.

(From our own Correspondent.)

The Great Eastern Railway Company's report and accounts show a substantial increase in the passenger receipts for the last half of 1886 and afford fresh testimony of improvement in Railway business. In the London and North-Western Railway Co.'s worshops at Crewe, some weeks ago, the men were put on an extra day, and now the whole of them numbering over 6,000 have been put upon full time. The whole of the men also in the locomotive works of the Midland Railway Company will go on full time this week. Recently they have been off on Saturdays, and before that only worked four days a week in consequence of the somewhat depressed state of the Company's business. These new orders must certainly indicate a revival in trade.

University College, Liverpool, has reason to congratulate itself on having some remarkably generous and enlightened friends. Last week it was announced at a meeting of the College Council that Mr. Thomas Harrison, shipowner of Liverpool, had endowed the Chair of Engineering with £10,000. Only a few weeks ago Sir Andrew Walker, also a citizen of Liverpool, gave £15,000 to build Engineering laboratories.

With a view of ascertaining whether a supply of water of proper quality can be obtained by means of artesian borings, the Commissioners of sewers of the City of London are going to sink a well, and if they succeed in finding water will commence by supplying a block of artizans' dwellings, the cost of the present supply to which is stated to be £100 per annum. It remains to be shewn whether economy will thus be practised in dispensing with the New River Company, and it is questionable whether the Commissioners are in a position legally to supply water to the inhabitants of the City and to take payments for the same.

The Mechanical Engineers are to hold their annual meeting next week at the Institution of Civil Engineers, when the discussion on Mr. Wylie's paper on Triple Expansion engines, which was adjourned at the last meeting will be continued. Mr. Henry Teague, of Lincoln, will follow with a paper entitled Notes on the pumping Engines at the Lincoln Waterworks. M. Marc Berier Fontaine gives a paper on the Description of a portable Hydraulic Drilling Machine, and lastly Mr. Edgar T. Rathbone, of London, gives one on Copper Mining on the Lake Superior District. I may possibly be able to say something of this meeting in your next Home letter.

At a recent meeting of the Institution of Civil Engineers a resolution was passed tendering to Lady Whitworth the sincere sympathy and condolence of the members in the bereavement she has sustained by the death of her husband, who was a member of the Council, and placing on record the high appreciation of the members of the distinguished services rendered by their late colleague during many years in promoting the advancement of the practice and teaching of Mechanical Science. The first paper read at the same meeting was on "Sewage Sludge and its Disposal," by Mr. W. J. Dibdin, F.C.S., F.I.C. The author deals only with water carried sewage, the main characteristics of which are first alluded to. The solubility of the suspended matters, and then the dissolved impurities and their partial removal. The precipitation of the suspended matters is subsequently considered. The use of "milk of lime" and the sulphates of alumina and of iron. The action of the salt, known as proto-sulphate of iron or "green vitriol" is then chemically described. The author then considers the alternative plan of filtration, remarking on the frequency and the causes of its failing, but admitting the adoption of the system as a further purification of the clarified sewage. Aëration is described, and the disposal of the sludge ultimately arrived at. In small cases where suitable land is available it should be dug in. As to sewage presses, they were only manageable where small quantities had to be dealt with—that every effort that had hitherto been made to reduce their cost had failed. The system adopted at Southampton of mixing the semi-liquid sludge with dry road sweepings was well mentioned. But in summing up the vast expense that would be incurred in the case of dealing with the metropolitan sewage, in pressing, burning or otherwise dealing with it; the conclusion is drawn that the only tangible and economical system available for the metropolis is to carry the sludge to the sea. The great advantage of which would be that the sludge would never be seen. Discharged in the open sea many miles from land it could not possibly be a nuisance to the coast, and as to the danger and delay likely to supervene from fogs and stress of weather, the author considered such an objection trivial in the face of the enormous maritime traffic which is now carried on with such perfect precision. The second paper was on "Filter Presses" for the treatment of sewage sludge by W. Santo Crimp, Surveyor to the Local Board, Wimbledon. The author first alludes to the difficulties arising from large masses of sludge to be disposed of being in a sloppy and very offensive condition, and of the constant endeavours to get rid of a great portion of this liquid—the use of screened town ashes as had been tried at Wimbledon. The costliness of drying machines was instanced where in order to reduce 100 tons of normal sludge to 20 tons with 50 per cent. of water about 12 tons of fuel would be required. Filter presses the author considers as best adapted for this purpose. At Wimbledon 250 tons, the weekly production of sewage sludge, was reduced by 2 filter presses to 50 tons of sludge cake containing 50 per cent. of water at a cost of 2*s.* 6*d.* per ton for labour, lime, fuel, cloths, &c., to which should be added interest on the original outlay and depreciation equal to 1*s.* per ton more. The author then calculates the cost of dealing in this manner with the sewage of the metropolis and gives the result of agricultural experiments when sludge cake was tried with super-phosphate and with farmyard manure. The yields being in the case of the sludge cake 13·15 tons, super-phosphate 12·60 tons and farmyard manure 12·27 tons, while the unmanured plot yielded 11·72 tons. The author is, therefore, of opinion that the filter press offers a ready means for the disposal of the putrescent mud produced in precipitation works and that this mud may be converted into a practically inodorous manure superior to farmyard manure. The discussion upon the two above papers was adjourned.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, February 26, 1887.

Colonel F. S. Stanton, R.E., Director-General of Railways, and Deputy Secretary to the Government of India, Public Works Department, vacates his appointment under notification in the Public Works Department No. 293, dated 3rd September 1880, with effect from the 26th February, and is re-appointed a Chief Engineer, 1st class, from the 27th February.

With reference to the above Notification and to Notification No. 45, dated 15th February 1887, Colonel R. C. B. Pemberton, R.E., Officiating Director-General of Railways, and Deputy Secretary to the Government of India in the Public Works Department, is confirmed in that appointment, with effect from the 27th February.

Colonel T. F. Dowden, R.E., Superintending Engineer, 3rd class, and Deputy Consulting Engineer to the Government of India for Guaranteed Railways, Calcutta, is appointed Consulting Engineer to the Government of India for Guaranteed Railways, Lucknow, *vice* Colonel R. C. B. Pemberton, R.E., appointed Director-General of Railways.

Mr. R. S. Strachey, Assistant Engineer, 1st grade, Burma Provincial Establishment, is permanently transferred to State Railways, and his services placed at the disposal of the Director-General of Railways.

Railways.

Mr. J. H. M. Smith, Assistant Engineer, 2nd grade, is, in the interests of the public service, transferred from the Ferozepore Bridge Works to the Tounghoo-Mandalay Extension of the Burma State Railway.

Mr. F. J. Pope, Executive Engineer, 4th grade, temporary rank, is granted furlough for eight months, with the usual subsidiary leave, with effect from the 1st April, 1887, or such subsequent date as he may be permitted to avail himself of the same.

Director-General of Railways' Notification, intimating that an extension of seven months' furlough had been granted by Her Majesty's Secretary of State to Mr. E. F. Gordon, Assistant Engineer, 1st grade, in continuation of the furlough previously granted to him, is cancelled.

Mr. W. Drew, Assistant Engineer, 1st grade, is, in the interests of the public service, transferred from the Sind-Pishin State Railway to the North-Western Railway.

Bengal, March 2. 1887.

Establishment—Railway.

Mr. G. Denchars, Assistant Engineer, 1st grade, passed the Departmental Standard Examination in Hindustani on the 22nd July 1886 while attached to the Northern Bengal State Railway.

Establishment—General.

Mr. J. S. L. Long, Assistant Engineer, 2nd grade, Tirhoot State Railway, is granted 14 days' language leave, with effect from the 15th February 1887.

Establishment—Irrigation.

Mr. A. H. Mason, Executive Engineer, 4th grade (temporary rank), attached to the Cossye Division, is granted eight months' furlough, with effect from the 1st of March next, or subsequent date.

Major A. D. McArthur, R.E., Executive Engineer, 1st grade, and Under-Secretary in this Department, is granted privilege leave for two months from the 24th instant.

Mr. R. B. Buckley, Executive Engineer of the Circular and Eastern Canals, is appointed to officiate as Under-Secretary in this Department, during the absence, on privilege leave, of Major A. D. McArthur, R.E., or until further orders.

Mr. A. E. Behrmann, Executive Engineer, 3rd grade, is appointed to hold charge of the Circular and Eastern Canals Division, *vice* Mr. R. B. Buckley.

Mr. C. J. L. Middleton, Executive Engineer, 4th grade, sub. *pro tem.*, on return from furlough is posted to the Orissa Circle.

Mr. J. P. Scotland, Executive Engineer of the Eastern Sone Division, is granted furlough for nine months from the 1st proximo, or such subsequent date as he may avail himself of it. The necessary subsidiary leave is also granted.

Mr. M. J. Monckton, Executive Engineer, is transferred in the interest of the public service from the Arrah Division and appointed to hold charge of the Eastern Sone Division, *vice* Mr. Scotland, proceeding on furlough.

Mr. C. H. DeMello, Assistant Engineer, 1st grade, attached to the Cossye Division, is granted furlough for nine months from the 20th proximo, or such subsequent date as he may avail himself of it. The necessary subsidiary leave is also granted.

Mr. O. C. Lees, Executive Engineer, temporary rank, is transferred in the interests of the public service from the Balasore to the Cossye Division, *vice* Mr. C. H. DeMello, Assistant Engineer, about to proceed on furlough.

Central Provinces, February 26, 1887.

Rao Sahib Dhondo Sakharam Sathaye, Assistant Engineer, is transferred temporarily to the Hoshangabad Division.

Burma, February 18, 1887,

With reference to *Burma Gazette* Notification No. 15, dated the 24th January 1887, Mr. J. Wallace, Executive Engineer, 4th grade, temporary rank, made over, and Mr. C. F. Gilbert, Executive Engineer, 4th grade, sub. *pro tem.*, received charge of the Bassein Division, on the forenoon of the 3rd instant.

Mr. A. J. Oldham, Executive Engineer, 2nd grade, is appointed to the 3rd Division, Tounghoo-Mandalay Railway Extension, extending from the 59½ mile to the 90th mile, with head-quarters at Ningyan. This appointment to date from the 1st February 1887, from which date the A Survey division will cease to exist.

Punjab, February 17, 1887.

Lieutenant H. C. I. Birdwood, R.E., temporary Assistant Engineer, 2nd grade, State Railways, is transferred to the Punjab.

N.-W. Provinces and Oudh, February 26, 1887,

Railway Branch.

The services of Babu Jogindro Nath Mookerjee, Executive Engineer, 3rd grade, sub *pro tem.*, attached to the Kalpi-Jhansi Division of the Indian Midland Railway, are re-transferred to the Irrigation Branch under this Government from such date as he may be relieved of his duties.

Irrigation Branch.

His Honor the Lieutenant-Governor, N.-W. P., and Chief Commissioner of Oudh, is pleased to prohibit all fishing with nets in the stream of the river Ganges at and near the head-works of the Ganges Canal within the northern limit of the town of Hardwar and the junction of the Myapur escape with the main channel of the Ganges river.

With reference to Notification, dated 21st December 1886, reposting him to the 2nd Circle, Irrigation Works, Mr. H. S. Wildeblood, Assistant Engineer, 2nd grade, is posted to the Bhognipur Division, Lower Ganges Canal.

With reference to Notification, dated 21st January 1887, transferring him to the 1st Circle, Irrigation Works, Mr. G. T. Anthony Assistant Engineer, 1st grade, is posted to the Aligarh Division Ganges Canal.

Madras, Feburary 22, 1887.

Mr. J. C. Larmine, Executive Engineer, 2nd grade, is granted twenty-one months' furlough from or after 2nd May 1887, under section 50 of the Civil Leave Code.

Major D. McNeil Campbell, R.E., Superintendent Engineer, 3rd class, sub. *pro tem*, is granted furlough (p. a.) for one year two months and seventeen days, from or after the 10th March 1887, under section 50 of the Civil Leave Code.

Mr. H. H. O'Connell, Executive Engineer, 4th grade, temporary rank, is granted furlough for eighteen months from or after 7th April 1887, under section 50 of the Civil Leave Code.

The following transfer is ordered :—Mr. W. C. Lewis, Assistant Engineer, 1st grade, from the Tank Maintenance Scheme to the 1 Circle for duty in the Godavari Central Division.—To join at the public expense.

Bombay, February 24, 1887.

Mr. Karpur Shriniwasrao, B.SC., L.C.E., is appointed to the Department as an Apprentice in the grade of Assistant Engineers on probation for one year.

Assam, February 26, 1887.

The undermentioned officer has been granted by Her Majesty's Secretary of State for India extension of leave, as advised in list dated the 21st January :—

H. W. Clift, Executive-Engineer, Assam, three months' furlough

Notices.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Answers to Correspondents.

C. W. M. (Rajghat—Bulandshahr).—Thanks: Query already sufficiently answered.

Obituary.

CONWAY.—At Jeypore, Rajpootana, on 19th February 1887, John Conway, P. W. Inspector, Rajpootana-Malwa State Railway, aged 46 years.

DOUGLAS.—In Camp, at Inkole, Kistna District, on 21st February, of cholera, John Christie Douglas, late Chief Superintendent of Telegraphs.

INDIAN ENGINEERING.

SATURDAY, MARCH 12, 1887.

THE PUBLIC SERVICE COMMISSION.
III.

THE present time in England has been called an era of commissions, and able editors who preach the views of that particular party that is for the moment "out" are fond of saying that the issuing of a Commission is a sign of weakness in the Government. There is, however, no necessary connection between weakness and appointments of Commissions. A Cabinet never holds more than an infinitesimal proportion of the weight of opinion in the country. Not only is it fairly entitled, but it is under perpetual obligations, to gather advice on important measures from the whole mind of the people. Its characteristic responsibility—its peculiar power—lies in its capacity to accept advice—or reject advice—and to carry such acceptances or rejections into great and immediate action.

In fact, when an opposition press denounces or ridicules the formation of a Commission its position is easily shown to be thoroughly illogical. For example, the *Pall Mall Gazette*—which lately did some excellent work in a needlessly theatrical style—is just now preaching against a Conservative Government; and if it be supposed that the members of the Government are under no obligation to acquaint themselves with the doctrines which that paper thinks fit to inculcate; its editor is thereby put out of court as an authorised critic of the Government. If on the other hand the Government are bound to read the opposition Press; this amounts to saying that the Government should constitute themselves into a Commission to take evidence from able editors.

Now just as the members of the Government focus in the council chamber a small percentage only of the whole insight of the nation, so the writers of the political press are only an insignificant portion of those who have opinions worth consulting. Of a member of the Government it can usually be inferred that his abilities are far above the average. There is, however, no reason to presume that the judgment of the writer of any political article, which appears in a daily paper, is specially great compared with that of some ordinary well-educated merchant, who is reading the article in the train on his way to his office in London. In fact the presumption might plausibly be stated to lie in the other direction; for in the first place the article is generally written in a desperate hurry, and secondly the habit which a professional political scribe acquires of belauding the wisdom of his own party and belittling the wisdom of the other party, is likely to conduce to shortsightedness in a vision that once was normal. If therefore the Government are bound to consult 'leader' writers—and this is the position virtually taken up by the very existence of this genus—they must *a fortiori* be bound to consult educated opinion generally. A Commission is the recognised method of gathering information from experts. No other and better method to-

obtaining information from the public at large has yet been practised or described.

The present Public Service Commissions are working at a certain restricted part of a proposed Civil Service reform. We have in India a body of Civil Servants who are known by the peculiar name of "Covenanted." We have a second body recruited in India whose work is more or less dovetailed into that of the Covenanted Civil Service. We have lastly various classes of professional or scientific men who are recruited in England and are constituted in India into what are called departments. The present Commissions are instructed to keep clear of these departments, but that is merely a detail of the working. A watchmaker may clean some wheels before he looks at others, but ultimately he must bring them all together and take account of their mutual relations.

The chief characteristic of increased civilisation is increased specialisations of function. This principle we see applied not only in manufacturing industry—as in making pins, playing cards, watches, and so on—but in all literary, scientific, professional, and political occupations. One medical man studies the diseases of the eye, another the diseases of the ear. One man busies himself in writing novels, another in writing history. If a man confines himself to doing some one thing it is that in the doing he may reach a high degree of excellence. In the so-called Covenanted Civil Service this useful principle has not yet been allowed full scope. But when this fine old service is remodelled in harmony with the conditions of the age, it will practically be brought into line with those special departments which are specially recruited in England.

We shall then have the whole Civil Service of India divided into two great branches. To this one branch appointments will be made by the Secretary of State in England. To the other branch appointments will be made by local Governments as at present. In any section of the first branch high proficiency will be required in the work appertaining to that section. The mode of recruitment of each section will be special and will have reference to the qualifications required. We shall all recognise the absurdity of having one and the same competitive or qualifying examination for Civil Engineers and Civil Surgeons. But we have not yet fully recognised the absurdity of having one and the same competitive examination for revenue and judicial departments.

The furlough and pension rules should be of the same main character for all those higher services which are recruited at home. Whether an Englishman is sent out to India to work as a revenue officer, or to act as a judge or to be engaged in the geological survey, or in any other occupation that implies social position, culture, training, and ability; he has practically the same sort of claim on the Government for justice and consideration.

Taking the sum total of the higher services, increased employment will gradually be given to natives. This may be effected in either of two ways. Firstly, the percentage of natives might gradually increase in certain selected departments. Secondly, the number of departments for which they are eligible might gradually be increased. Native gentlemen would certainly prefer the latter of these two plans. Particular departments which were specially or wholly reserved for natives, would tend to lose prestige. By retaining in each department a suitable proportion of Englishmen we keep each department in touch with all the others. No one who has had official experience in India can fail to see the great importance of this sympathetic communication.

MUNICIPAL APPOINTMENTS IN BURMA.

Some time back a Draft of rules was framed by the Chief Commissioner, under Section 32 of the Burma Municipal Act, prescribing the qualifications requisite in the case of persons appointed to offices requiring professional skill. The said rules provided that—(1) No person shall be appointed to a post of Municipal Engineer or Superintendent of Municipal works carrying a salary of Rs. 300 or more in any Municipality who is not certified by the Chief Engineer, Burma, to be, in his opinion, possessed of the professional qualifications necessary to the due performance of the duties which he will be required to perform ; and (2) no person shall be appointed to a post carrying a salary of Rs. 100 or upwards in any Municipality who is not similarly certified to be, in his opinion competent for the post by the Executive Engineer of the district in which the Municipality is situate.

These proposals were duly considered by the Rangoon Municipal Committee, which recorded its objections to the Rules as being inapplicable to that Municipality. The reasons assigned for this dissent are that as regards rule 1, the Committee have ample means of satisfying themselves when engaging an Engineer, as to the proper professional qualification necessary for the due performance of the duties which they would require him to perform. And, moreover, they consider that the rule as proposed, would interfere with the Committee's independence in the matter of such appointment. As regards rule 2, the Committee consider that the Municipal Engineer would be the proper person to certify, as to whether a person was competent to perform the duties required of Subordinates or those drawing salaries of Rs. 300 or less. This rule may be necessary for Municipalities not having a duly qualified Engineer, but in Rangoon it appears inexpedient to refer to the Executive Engineer of the District, for a certificate for a Municipal Sub-Engineer or Overseer, when the Committee can refer to their own Engineer, who is responsible for the work of the Department in which the appointment is made.

The Rangoon Committee, however, appear to forget that the ultimate ratification of all appointments rests with Government. The Chief Commissioner's rules are prescribed with the sole object of securing fit and proper agency. They would not interfere with the nominations made by Committees, unless they are unwise or undesirable on public grounds. Their aim is to ensure a judicious selection on the part of Municipalities, and intervention on that score is not only imperative, but justifiable on the part of Government.

THE WATER-SUPPLY OF CALCUTTA.

AFFILIATED in a large measure with the drainage scheme, but far more important in its bearing on sanitation, the subject of our article has a perennial interest, inasmuch as it is intimately connected with the abnormal mortality that threatens to be a permanent scourge to the Indian Metropolis, but in regard to which there is a consensus of opinion that it is due mainly to causes altogether preventible. Statistics too tell their mournful tale. That in Calcutta and the suburbs 24,000 inhabitants should have fallen victims within the last six years to a disease the ravages of which are subject to control seems appalling, but it is nevertheless a fact. While the Government commands resources in every department of the administration to meet extraordinary exigencies, such as famine, drought, &c., in the instance of averting a pestilence its helplessness is the more striking. So far back as 1855 Mr. William Clark submitted a scheme for drainage works; in the following year it was referred by Government to a specially selected Committee, which recorded its opinion that a diffused system of water-supply over the town was a necessary adjunct to complete drainage. Its cost was estimated at eleven and a quarter lakhs, and as the drainage system would cost thirty-two and half lakhs, the Committee recommended an expenditure of at least five and half lakhs a year, so that the combined system might be completed in ten years. It was approved by Government and the works started in 1859 in the Southern Division of the town. In this connection the following note appears in Mr. Beverley's Reports on the Census of Calcutta in 1876 :—It has been hinted that the Europeans acted somewhat selfishly in commencing these works in their own quarter of the City. But it was pointed out by Mr. W. H. Bayley, Chief Secretary to Government, so long ago as 1818 that the prevailing winds being from the south, every improvement in the European quarter benefits the whole town, whereas the same cannot be said of improvements in the Northern Division.

Up to 1870 the sources of water available for all domestic purposes in Calcutta were the rivers and the tanks and wells scattered throughout the Town. This was not only precarious but injurious to health. There were two projects placed before the Justices, one was for taking the supply from a point near Cossipore and the other that it should be drawn from the river above Barrackpore, where the water was, owing to its distance from Calcutta, comparatively uncontaminated by sewage. The matter was referred to the Government Chemist, Dr. Macnamara, who conclusively proved by analyses that the former project would confer no real benefit to the people. Since then the latter scheme has, to a certain extent, been completed, with the result that it has cost the City sixty-five lakhs of rupees, and Rs. 1,41,000 are annually expended on its maintenance and distribution; 118 miles of piping have been laid; 1,044 hydrants fixed; 15,187 houses connected and supplied; eight million of gallons are distributed daily, or 18½ gallons per inhabitant to a population at a rough estimate of 400,000. This, to say the least of it, is far below the actual requirements of the people, and is confined to those who pay for their supply; but when confronted with facts the proportion dwindles down to a mere fraction, for according to the Administration Report for 1885, "nearly the whole supply is taken by, say, three-fourths of the town, and the other-fourth, chiefly consisting of the western section of the Town and Hastings, gets scarcely any water."

In order to obviate this difficulty, and bring the supply more in harmony with the requisite demand, a new 48-inch main, capable of carrying 12 millions of gallons was successfully laid twelve months ago. As the programme stands it is contemplated to supply twenty millions of gallons per day, instead of a little over eight millions as at present; of the additional twelve millions, eight will be for the Town and four for the Suburbs. The capacity of the engines at Pultah head-works being restricted to only eleven millions per day, a new set of engines has been ordered which it is expected will be at work by the beginning of the next official year. As the carrying power at present exceeds the supply and the filtering power, the number of settling tanks would have to be increased to render it possible to filter fourteen millions of gallons per day. The old 42-inch main and the new 48-inch main combined carry over twenty millions of gallons, and in order to keep pace with the supply the pumping power has been increased at Tallah, and the engines there can now distribute upwards of twenty-one millions of gallons per day. But as we have observed this supply is unequally distributed, and in order to equalize it a piece of land has been taken up for the erection of a new pumping station for the west of the Town; but since the work cannot be finished before another two or three years, it is apprehended that this undesirable state of affairs will be continued for some time yet.

As we have already exceeded the space we proposed to ourselves for this article, we will reserve for the next number of our paper a discussion on the laying down of the new 48-inch main, or as it is popularly known as the "Battle of the Main."

MELENITE.

MILITARY and scientific men in France are just now extremely excited about a newly discovered, or newly invented, explosive, which they call "Melenite."

A large concourse of those interested in the subject was lately held at a town called Bourges, among whom was General Boulanger, the Minister of War. The object of the meeting was to witness various experiments made with the explosive. Its power is said to be to that of gunpowder as 100 is to 1; and to that of dynamite as 10 is to 1. What it is in composition has not yet transpired. Its name is supposed to be derived from the Greek word "melas," meaning black. We must wait until we hear the result of the trials before we can pronounce definitely upon this said-to-be wonderful substance. The French, who love mystery and sensation, are doing all they can to keep the matter dark; but where the public are admitted it is scarcely likely that the world will be prevented from soon knowing all about it.

Messrs. Ransomes Sims and Jefferies the well-known Agricultural Engineers of Ipswich, have just appointed Mr. F. W. Shallis, Consulting Engineer of Bombay, to represent them in the Bombay Presidency, Rajputana and Central Provinces.

Notes and Comments.

Local Appointments in Australia.—A Correspondent writing to us says that the treatment accorded by the Sydney Aldermen to their officers is so scandalous that he should like to take every step in his power to warn brother Engineers that the Municipal Service in the Australian Colonies is unfit for gentlemen.

Bengal-Nagpur Railway.—A question of the day in Professional circles in the Lower Provinces is—"To whom will the Prize of the Chief Engineership of the *new* Guaranteed Line fall"? Speculation is rife as to the favorites; but we have an idea that the selection about to be made will be a surprise to many—in many respects.

Boiler Inspection in Burdwan.—A Meeting of the Mine Managers was convened the other day to discuss the proposed extension of the Presidency Boilers' Inspection Act to the Raniganj Sub-division of the Burdwan District. It was decided that the intended measure is uncalled for and unnecessary and that Government interference with the present happy-go-lucky state of things was undesirable in the extreme! These views, strange to say, were elicited from some of the most strenuous advocates for a Mines' Regulation Act!

Madras Drainage Works.—Colonel Pennycuick, R.E., the Chief Engineer for Irrigation, informed the Madras Government, that as the proceedings of Mr. J. A. Jones, the Municipal Engineer, in connection with the Madras Drainage works appear to have been subjected to no small amount of hostile and exceedingly unfair criticism, he therefore thinks it desirable to say that, in his opinion, these proceedings leave nothing to be desired; that the work is being carried out in a most efficient and economical manner; and that the Commissioners have every reason to be satisfied with the manner in which the funds provided by them are being expended.

Telegraph Engineering in Persia.—A Correspondent, writing to us from Shiraz, under date the 16th January last, says:—During the recent snowstorms, I received official intimation that 25 miles of wire had been blown down on the Shiraz-Kazaroon Section of the Line, and had to proceed forthwith to the scene of the disaster. On arriving there I found hundreds of poles shattered to pieces and the wires under deep snow—in one place for no less than three miles at a stretch. This necessitated our working knee-deep in snow, during inclement weather, and despite all our efforts we could only set up the International wire, leaving the local and Persian lines on the ground till more favorable season.

The Lahore Tramway Company.—We have already noticed the Tramway scheme in the Punjab capital, and pronounced it a paying and prosperous concern. A very important matter for consideration in connection with the undertaking, as regards its commercial prospects, is the small amount of capital which has been expended; the total being about two lakhs. The line includes as standing stock,—five miles of permanent way, twenty-six passenger cars, three goods waggons, about 2½ acres of land, a large and commodious office, tram car sheds, stabling, &c. This shows remarkably well on the result up to the present, and compares favourably with the Kurrachee Tramway, which cost eight lakhs for nearly the same length of line.

The Rewah Coal.—It would appear, judging from the remarks of a contemporary, that this coal is not finding favour with the mill-owners at Cawnpore, who have been induced to describe it as "hard and flinty" and as requiring a "Nasmyth's hammer" to reduce it into convenient sizes. To enable them to use the coal with any degree of success they have to mix it in small quantities with the Bengal mineral! The reason is not far to seek as the character of the Rewah coal is such that, to use it more successfully and therefore economically, it must be burnt in boilers of high drawing power. When used in Locomotives it is said to answer admirably, and to be next in mileage consumption and caloric power to the Karharbari mineral.

Promotion in the Ceylon Public Works Department.—A number of changes have lately been sanctioned in the Ceylon Public Works Department. Amongst others, Mr. Prime, the Provincial Engineer at Badulla, goes to Galle, to act in that capacity, being relieved by no less a person than Mr. C. E. Spooner, who will thus act as Provincial Engineer of Uva, stepping over the heads of no less than twenty seniors. Mr. Venning will succeed Mr. Spooner in Kandy, and be himself succeeded by Mr. Bingham at Negombo. The Railway Engineers' Department will be glad to get Mr. Spooner so far removed from the Blackwater Slip at Badulla, and this pet officer of the Public Works Department has certainly no reason to find fault with the result either of his "squirting" operations, which were in themselves a failure, or the reasons which led to their being permitted.

The Public Service Commission.—Mr. James Henderson, of the firm of George Henderson and Co., jute merchants, Calcutta, said in evidence, that experiments were tried some years ago of using native supervision in their work, but this did not prove a success and had to be abandoned. He did not consider the new school of natives, in spite of being better educated, as being superior from a business point of view to the old school; and many native firms doing a large business employed Europeans in positions of control, and business was then carried on successfully on European lines. During the 30 years the jute industry had been established, not a single native had been found competent to take charge of jute works, skilled European labour having to be imported from Dundee. The employers would be glad to use natives if only competent men could be found.

Launch of a Spanish Cruiser at Hong-Kong.—On the 5th February, the first sea-going man-of-war built in Hong-Kong was launched with considerable ceremony from the H. and W. Dock Co.'s establishment at Hung Hom. She is 186 feet long, and has been built to the order of the Spanish Government. The *Filipinas*, for such the vessel has been named, is a twin-screw steel ram cruiser, and will resemble the well-known *Scout* class of the British Navy, with the exception that she will not be fitted with torpedo tubes. These may be fitted in hereafter. She is a vessel of 475 tons gross, and her engines are of the compound surface condensing type, giving, when working at full speed, an indicated horse power of 650, the estimated or rather guaranteed speed being twelve knots. Her armament will consist of three 3-ton breechloading guns, of Spanish manufacture, and a number of machine guns. We believe the contract price for the hull and machinery alone is $120,000.

Military Buildings, Upper Burmah.—In Lower Burmah the practice has been for many years to build frame barracks of teak wood. These structures are erected in one-third the time and at one-third the cost of masonry

barracks; they are suited to the climate, where the heat is never so great as in northern India, and they provide, moreover, for everybody sleeping several feet above the ground—a provision absolutely necessary to health in the Burmah climate for several months of the year. There is this further advantage in wooden barracks that, if a site turns out unhealthy or otherwise and undesirable, the barracks can be taken down, re-erected in another site at a cost of a fourth or one-third the original outlay. The total cost of the barracks still required will be 21 lakhs of rupees. This includes officers' quarters and all subsidiary buildings, except recreation-rooms, gymnasia and churches. The estimate includes accommodation for horses, mules, and commissariat buildings. Out of the whole sum, about two to three lakhs will be spent before the 31st March out of the Military Works grant of the year 1886-87. The balance, or about 18 lakhs, will, subject to the sanction of the Supreme Government, be spent during the year 1887-88.

CAWNPORE COTTON INDUSTRY.—There are two points of difference between the cotton industry as it is carried on in Cawnpore and as it exists in Bombay or Bengal. Possibly because they are nearer foreign markets for the yarn and nearer also to the competition of foreign weavers, the mills of Bombay and Calcutta either devote themselves wholly to spinning, or weave only a small proportion of the total outturn of yarn. In Cawnpore, on the other hand, all the mills are now both spinning and weaving. A large percentage of the yarn spun in each mill is turned into cloth on the premises, and this percentage is constantly on the increase. Another point of difference is that the element of speculation seems to enter into the transactions of the Cawnpore mills in a less degree than happens in the case of those of Bengal or Bombay. The Cawnpore mill seldom deals directly with the consumer of the cotton yarn it sells: its transactions end with the native contractor in Cawnpore itself, who buys the yarn and depends on himself to find a profitable market. This saves the expense of sale agents and minimises the risk of bad debts, since the native dealer will endure many small losses in this way before he goes into liquidation and causes loss to the mill.

RAILWAYS IN MADRAS.—We learn that the Directors of the South Indian Railway Company in England have issued detailed instructions to their Agent in India to communicate with the State for the purchase of that section of the Cuddapah-Nellore State Railway from Tirupati (Ranigunta) to Nellore that is to be opened for traffic very shortly on terms similar to those under which the Southern Mahratta Company purchased the Bellary Branch of the Madras Railway. He has also been authorised to negotiate for the construction of the extensions from Nellore to Dharmavaram and from Villupuram to Pakal; and to urge upon an early settlement being arrived at as to the terms under which the Travancore State are prepared to contribute towards the construction of the Tinnevelly-Quilon Railway,—the southern route, or that *viâ* Shencotta and the Ariankavu pass, being adopted for the alignment of the line. The Government themselves being in favour of the Board's proposals, arrangements are to be concluded at an early date for giving effect to the same. These arrangements when carried out, coupled with the transfer of the Bellary-Kistna State Railway to the Southern Mahratta, as suggested recently by the Imperial Government, will eliminate the State Railway agency in the Madras Presidency.

Current News.

WE regret to have to record the death of Major-General H. F. Hancock of the Royal Engineers, which occurred at the United Service Club about 6 A.M. on last Wednesday morning. He will be widely regretted both officially and socially, for he won regard and esteem wherever he went. He was interred with the usual honours at the military cemetery the same evening.

SHOCKS of earthquakes are said to have been felt at Simla, Mussoorie, and Dehra.

MAJOR CARTER, Inspector of Sub-Marine Defences, has proceeded to Karachi on inspection duty.

SIR THEODORE HOPE leaves Calcutta on the 17th instant, and inspects the Purneah Railway on his road to Delhi.

A SILK CONFERENCE will be held in Calcutta this week, at which a detailed plan for practical work will be drawn up for the season.

COLONEL ÆNEAS PERKINS, C.B., Chief Engineer and Secretary to the Punjab Government, in the Public Works Department, goes on furlough shortly.

A RESIDENT of Calcutta has adopted electric lights for the lamps of his barouche, and his carriage now forms the object of much attraction after dusk.

THE Municipality of Ahmedabad, Guzerat, has resolved upon a water scheme to supply up to 10 gallons per head. The estimated cost of the scheme is six lakhs of rupees.

LAST year the Foundation Stone of the Rangoon Cathedral was laid by the Viceroy, and from that day to the present not one single brick has been added to the building.

MAJOR GRACEY, R.E., Chief Engineer of Provincial Railways in the N. W. Provinces, is understood to have been offered and to have accepted an appointment as Chief Engineer in Upper Burmah.

THE portion of the Sind-Pishin Railway finished beyond Quetta, has been taken over by the Manager of the N.-W. Railway, and will be opened for passenger traffic from Rindli to Quetta very shortly.

LIEUTENANT-COLONEL GOLDIE, R.E., has taken over the duties of Superintending Engineer, Sirhind and Lahore Command, Military Works, from Lieutenant-Colonel Manderson, who has proceeded on privilege leave.

THE throwing open at once of the Sind-Pishin Railway by an Act carried through in all its stages at the recent meeting of the Supreme Legislative Council will be recognized as a sensible step carried out with commendable promptitude.

COLONEL FORBES, R.E., the Chief Engineer of the Irrigation Department in the N.-W. Provinces, proceeds almost immediately on eight months' furlough. Colonel Jeffreys, R.E., Superintending Engineer, 1st grade, acts for Colonel Forbes.

MR. CROSTHWAITE, the new Chief Commissioner of Burmah, has instructions to inquire into the position of matters as regards the ruby mines, the relations of the late Burmese Government towards the miners, &c., and to report fully to the Government of India.

COLONEL C. M. BROWNE, R.E., Secretary to the Chief Commissioner of Burmah, in the P. W. Department, is to succeed Colonel S. T. Trevor as Secretary to the Government of Bengal in the Public Works Department, on the latter's retirement at the end of this month.

THE Engineers on the Madras Railway, it is said, are to fare badly, and are to have their salaries cut from Rs. 800 to Rs. 600. The appointment of Agent is to be amalgamated with that of Chief Engineer or Loco-Superintendent, and the salary of the combined appointments is not to exceed Rs. 2,500.

PLANS and estimates of a scheme to provide Rawul Pindi with a good water-supply, to cost two and a half lakhs, have, according to the Lahore paper, been approved by Government. The Municipality provides Rs. 1,19,000 from current income, and goes into the open market for the rest, borrowing at six per cent.

WE learn that Mr. T. W. Hughes, the Deputy Superintendent of the Geological Survey of India, whose services were temporarily placed at the disposal of the Hyderabad Deccan Mining Company by the Government of India on his recent arrival from England, proceeded to Singareni the other day and surveyed the coal fields.

IF the existing precedent is to be followed, in placing a Civilian at the head of the great spending departments, the selection of the next Public Works Minister will not be embarrassed by too many possible candidates. There is indeed one man who seems to reduce the number to almost a unit. We mean Sir Charles Elliott.

MR. W. H. WHITE, C.E., an able engineer whose services have been lent to the Morvi State by Government, has succeeded in completing the Morir railway works in spite of many difficulties, and the line is now open for public traffic. This is creditable to all concerned. His Highness is further anxious to lay a branch line between Wankaneer and Rajkote. The land in connection with this is now being surveyed.

A LETTER from the Bengal Government, Public Works, states that in exercise of the power conferred on him by section 4 of the Howrah Bridge Act, 1871, the Lieutenant-Governor is pleased to exempt wheat from payment of the terminal charge levied on goods conveyed on the East Indian Railway into and from the

station of Howrah. This exemption will have effect from the first day of April 1887.

It is officially announced that, from the 1st of April next, the control of the Eastern Bengal State Railway and of the railways worked by it, shall vest in the Government of Bengal. On that date the general control and management of those lines and of the staff employed thereon, will be transferred from under the administration of the Director-General of Railway to that of the Government of Bengal.

Mr. Jamsetjee N. Tata, who recently bought the Dhurrumsey Mill, has since transferred it to the Swadeshi Company, which Mr. Tata was instrumental in forming a few months ago for the purpose of spinning yarns of the higher counts. He has transferred the mill at the price at which he bought it—namely, twelve lakhs. The capital of the Swadeshi Company, originally eight lakhs, is to be increased by seven lakhs.

The section of the Assam-Behar State Railway from Motihari on the Ganges to Purneah was opened by the Lieutenant-Governor of Bengal on the 5th instant. This piece of line brings the Assam-Behar into connection with the East Indian Loop Line on the other side of the Ganges, and will tap the traffic of the Purneah district, to whose chief market at Kusbah, five miles from Purneah, the railway is now open.

Colonel Lindsay, Chief Engineer, Southern Mahratta Railway, leaves Bombay for England this week. His departure will, a Poona correspondent remarks, "be a great loss to the Southern Mahratta Railway as he finally severs his connection with the line." He has had under his superintendence 700 miles of railway already open. On the 22nd instant the remaining portion of the line to Belgaum from Dharwar will be opened for traffic.

The last *London Gazette* brings the news of some changes of importance to the members of the Bombay Public Works Department. General Goodfellow's promotion to Lieutenant-General will cause him to vacate his appointment as Secretary to Government on the 31st March, and Colonel Bonus's promotion to Major-General obliges him to vacate at once, as he is not a Chief Engineer, 1st grade. This will mean two steps of promotion throughout the Department.

The Special Committee of which Lieutenant-Colonel B. Blood, R.E., was President, recommended, and the Government of India have sanctioned, that departmental military subordinates, while temporarily doing duty with troops in the field, should be granted the same amount of pay, &c, including sub-divisional allowance, which they drew in the civil appointment. The sub-divisional allowance should, however, be restricted to those who were actually in receipt of it at the time of transfer to military duty.

The Consul General at Pondicherry has just authorised the administration to negotiate with the British Government upon the subject of constructing a branch line of railway from Pondicherry to Cuddalore. The Travancore Government have again decided in favour of a northern route, and in effect say they do not want the line to be taken to Trivandrum, and that a railway from Tinnevelly to Quilon will answer their requirements. This decision is under the consideration of the Madras Government.

The first section of the Bellary-Kistna line is to be opened on the 1st proximo, and the works at present in execution will be inspected by the Consulting Engineer for Railways on the 15th instant. The Locomotive Superintendent is fitting up engines, &c., and has indented for vehicles of various kinds, first, second and third class carriages, open and covered goods' wagons, and brake, powder, and mail vans, but as these will not arrive for sometime to come, the Southern Mahratta Railway will work the line for six months at least.

The telegraph line will, it is hoped, be completed to Bhamo by the end of this month. The men employed in its construction have come upon frequent traces of a former line, the work of the late dynasty, which appears to have been ruined mainly by the big beasts of sorts that roam the forests of those regions. A corresponding risk has, as far as possible, been avoided in the present case by carrying the wire across and across the river and through as much open country as could be found. The job is a tough one.

It is stated by a London correspondent that a company has been formed "to take over and carry on the valuable and extensive foundry and engineering works in India, which for many years past have been in successful operation under the Public Works Department of the Government there, and have been secured under contract with the Government in pursuance of its policy of withdrawal from competition with private enterprise." It is understood that the company is about to come before the public under first class auspices.

Mr. B. V. Rajwode, of Bombay, has arrived at Khurruckpur, near Jamalpore, at the invitation of Maharajah Sir Luchmeswar Singh Bahadur, of Durbungah, to consider as to the practicability of establishing a glass manufactory on the Maharajah's estate there. The spot suggested is about 18 miles south of Monghyr, and about the same distance from Jamalpore. Sand suitable for glass-making is plentiful, as well as very clear quartz. It is to be hoped that the attempt will prove successful, as glass-making is an industry that might be greatly extended in India.

The bridge over the Gunduck River on the Tirhoot State Railway at Hajipore is, we learn, rapidly approaching completion, and is expected to be opened for traffic by Sir Rivers Thompson at the end of this month. The first stone was laid by him in presence of Sir Alfred Lyall in January 1885. The bridge is 2,000 feet long and consists of eight spans of 250 feet each of steel resting on massive masonry piers. The level abutment joins on to an arched viaduct half a mile in length over the Sonepore Fair ground and with the Bengal and North-Western Railway at their Sonepore station.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.]

GARSON'S PATENT SUSPENSION BRIDGES.

Sir,—There are one or two points connected with Garson's Patent Bridge noticed in your issue of 19th February that require elucidation.

Firstly.—The Stress Diagram is correct for the Frame Diagram given above it, but the introduction of a top centre link in the Bridge Drawing given below, completely alters the case; the structure is no longer hinged in the centre, and the strains can only be correctly ascertained by a method analogous to that for a metal arch, hinged at spring and continuous at crown, the sense of the strains being of course reversed.

Is this link loose, and only put in for appearance?

Secondly.—Assuming the structure to be as shown in Frame Diagram, there is a resultant pull on head of pillar, of which the vertical component is 3·25 tons. There is also a back stay with a similar strain, yet the total on pillar is figured as 3·25 only, whereas it should apparently be double that amount.

Thirdly.—The strength of connexions appears open to doubt. For instance, the pull on top bar F is 5·725 tons, and there is a $1\frac{1}{2}$ inch pin in two $\frac{5}{8}$ inch flats to transmit this strain, which makes the pressure on bearing area of pin 6·88 tons per square inch, whereas 4 tons is usually considered enough.

As regards the "Patent" there is nothing new in it.

This class of bridge was noticed in a discussion on the subject of Suspension Bridges in the Institution of Civil Engineers in London many years ago, by Mr. J. Whiting, M.I.C.E., now in the Irrigation Department, Bombay, and was tried on a large scale at Chatham, being an easily constructed bridge for field purposes.

F. E. R.

PROVINCIAL PUBLIC WORKS, N.-W. P. AND OUDH.

Sir,—Your Correspondent, "R.," writing in your issue of the 26th ultimo, under the above heading, is labouring under serious misapprehension in all the "facts" referred to in his para. No. 3 as far as our firm is concerned.

We do not wish to make any remarks regarding the Roorkee Workshops, &c., although the statements made by your Correspondent are entirely without foundation, but we must ask you to correct the inference which would naturally be drawn from the concluding sentences of the paragraph referred to.

As a matter of fact, we have a separate department devoted to the execution of bridgework as a speciality, and a considerable portion of our business consists of such work for Government through the P. W. D., &c. We have a large staff of practical English foremen thoroughly acquainted with the details of work of this class, and also complete plant, tools, &c., for the manufacture of it. This is generally known throughout the country, but to prevent misconception it is, of course, advisable that statements so diametrically opposed to actual facts, as those made by your Correspondent, should be corrected, and we will thank you to publish this in your next issue.

Richardson & Cruddas.

DECAY OF BRICKS.

Sir,—I observe that in a small paragraph on the decay of bricks in the issue of your valuable *Journal* of the 15th January last (No. 3, page 33), it is stated that though the decay is usually attributed to the action of heat, wet and frost, the real destroyer is a microscopic creature, the action played by the weather being secondary, as shown by the observations of M. Parize.

The subject is of such vast importance to the practical work of an Engineer, that I trust I may be excused for referring to it again. It may be quite true that in the cases that came under the observation of M. Parize he has found, with the help of a powerful magnifying instrument, numerous microscopic animalculæ in the decayed brick dust. It, however, appears to me, that this circumstance alone cannot prove that the supposed animalculæ are the cause of the decay of bricks. It is quite possible that he may have mistaken the minute crystals of salt in decaying bricks for living organisms, or, it may be, that the organisms may have formed after the decay had already set in from another cause. At the same time it is difficult to believe that in a brick, whose vegetable matter is burnt and lost in the kiln, there would be anything attractive, either for germinating or sustaining animalculæ life on a large scale.

I have often carefully observed bricks and soft stones readily giving way to weather and crumbling into dust within a few years of their being used in the walls or floorings of buildings, and have, as a rule, invariably been able to trace the cause to the presence of salt in the brick or stone so affected. The fact of salt being a great destroyer of such materials is well-known among masons in this country.

This salt finds its way in the stone or brick either in the stone quarry or brick earth or subsequently from the contact of salt-ground or water, or even from the presence of salt in the atmosphere surrounding salt and marshy grounds and sea coasts.

The action of salt on these materials is mostly mechanical and is hastened by inclemencies of weather and alternate exposure to salt water and air. Under microscopic observation the salt on the surface, when dry, presents regular cubical-shaped figures. The action is thus explained. Common salt being highly absorbent is drawn out to the surface in a liquid state by the heat and moisture in the air, and, when dry, forms into regular cubical crystals requiring more space than before. The surface of soft stone and brick thus gives way as the action continues from surface inside. Harder materials also suffer from this cause, though in a much less degree.

In the remedies applied to prevent, as far as possible, the decay of materials due to this cause, the principle observed is to make the surface hard and impervious to moisture after previously washing it with plenty of water to remove the surface salt.

G. R. T.

Literary Notices.

Some Books on Applied Mechanics.

We have to welcome the appearance of another book on Applied Mechanics. The exact title is "The Mechanics of Machinery." The author is Professor Kennedy of University College, London. This is a good time for students of Applied Mechanics to take the trouble to be born as Figaro puts it. There are many excellent treatises on Applied Mechanics and the cry is still they come.

The subject of Mechanics may be divided initially into two branches. One of these is usually called Rational Mechanics The other (not irrational) is called Applied Mechanics. In the former we demonstrate the paralellogram of forces, the formula for the lever—the theory of couples—the principle of virtual velocities, and so on. This latter principle has lately been called the principle of virtual work. The best English book on this branch is that by Professor Minchin of the Royal Engineering College at Cooper's Hill. It is called a "Treatise on Statics."

In "Applied Mechanics" we see the principles of "Rational Mechanics" at work in machinery. As one of the simplest possible machines let us consider a fixed pulley. If this pulley is tolerably smooth, where the smoothness relates not to the play of the rope or leather in the circumference, but to the rotation of the axle in its bearings, we have by the action of the pulley a force simply changed in direction. This, however, is only a rough statement. In reality the pulley rotates against the inappreciable friction of the air and the more appreciable friction of the bearings. Force must therefore be constantly supplied to the pulley to preserve its rotational velocity. Again, the rope or strap is imperfectly flexible, so force is needed to flex it when it reaches the pulley. It is also imperfectly elastic, so force is afterwards needed to unflex it. These forces must be taken out of the motive force. In other words, let P be the original force applied at one end of the band. Let Q be the force transmitted to the other end of the band. Then Q is less than P. In this simple case we see the habit of all machinery to exact a commission—as a Banker or Agent might describe it—for doing work. In any machine you put so much power in, you can only recover a certain fraction of your deposit. This fraction may be called the "efficiency" of the machine.

Now, if we simply divide Mechanics into two branches, the second branch is enormously more bulky than the first. In fact, in such a dual division, we have tacitly treated geometry and all branches of pure mathematics as simply servants of physical science, and we have taken no account of the labour, however arduous, which these servants have to undergo. But now-a-days the mere geometry involved in the study of machinery is considerable. Thus one book has been written by Dr. Zeuner exclusively on the geometrical aspects of valve gears. Accordingly we find it convenient to sub-divide Applied Mechanics into two branches.

In the one branch we consider the action of force and the transmutation of one force into another. This transmutation when most simple as in the ideal weightless pulley and perfectly flexible strap, consists merely in a change of direction. It may be less simple as in the screw or the wheel and axle where one force disappearing gives birth to another much greater, or the transmutation may become extremely complex as in the steam engine. Here the chemical energies of coal and oxygen are first employed to change cold water into hot steam. The hot steam is replaced by colder steam *plus* some mechanical power. The consideration of these laws of force is sufficiently difficult without having the argument constantly interrupted to consider what we may by analogy describe as the mere geometrical transformation of one movement into another.

Hence we have the second sub-division constituted as a subject apart. This we may call the "Principles of Mechanism." Such in fact is the exact title of an able work on this subject by the late Professor Willis of Cambridge University. The book is pubt lished by Messrs. Longman. A few years ago Professor Kennedy translated from the German a treatise by Professor Reuleaux. This was entitled "Kinematics of Machinery." In modern phraseology "Kinematics" means motion studied as pure geometry. "Kinetics" is then used as a word for motion considered as produced by force. In this way we may say that the whole subject of Mechanics is divided into three parts. In the first we have Rational Mechanics, or as we should prefer to say, Abstract Mechanics. Secondly, we have Kinematics. Thirdly, we have Applied Mechanics. A work on Kinetics is really a work on Abstract Mechanics.

Suppose a body starts from rest and moves in one straighline under the action of a constant acceleration. How far will it travel in a given time? We can ask this question as a pure geometrical problem, that is, we need not ask what force produces such a motion, or even whether such a force could exist. In fact this motion is ideal. We know of no case in nature where a body describes a straight line with a truly constant acceleration. A body falling through the air certainly does not so move. In the first place the "gravitation" increases as we approach the earth's surface. Secondly, the air resistance is always increasing, partly because the velocity increases and partly because the density of the air increases. Lastly, the body is more or less influenced by the rotatory and translation motion of the earth in space. If we ignore these extra elements it is partly because we are studying a case of relative motion and partly because mathematics—as lately pointed out in this *Journal*—are not exact sciences, but sciences of just or well considered approximation. In Kinematics of Machinery we do not undertake to trace the transformations of which power experiences as it passes through a machine. This we leave to Applied Mechanics. A machine for the present is simply a series of parts so connected that if one part takes a movement of a certain magnitude in a certain direction another part must take a movement of some other magnitude in some other direction. If when the former movement is given there is no doubt about the latter movement as regards its magnitude or its direction, the machine kinematically is perfect. But whether in Applied Mechanics it is a good machine depends on whether it works smoothly and on other mechanical conditions.

Messrs. Macmillan lately published a treatise on Applied Mechanics by Professors Alexander and Thomson. This is elementary and is in two small volumes. The same great firm have still more recently published "Applied Mechanics" by Professor Cotterill. This is a much more complete treatise and may be strongly recommended. When we see a large book on Applied Mechanics—then because the two branches are not yet separated by well defined boundaries—we may expect it to introduce more or less some "Kinematical Discussions." The most complete treatise on Applied Mechanics, assuming the old dual division, is that by Dr. Weisbach of Freiberg. This has (partially) been translated into English. There are now four volumes in the English translation. The work is entitled a "Manual of the Mechanics of Engineering and of the Construction of Machines." Here we see the Sub-Division of "Applied Mechanics" into two branches distinctly indicated. The volumes are published by two different American firms, but they can all be procured through Messrs. Trübner of London.

General Articles.

THE MADRAS HARBOUR:

Its Construction, Destruction, and Reconstruction.

II.

The remaining proposal was that made by Colonel Orr and Mr. DeClosets, *viz.*, a breakwater of rough stone on the principle of the Plymouth breakwater, to be constructed parallel to the beach, at the distance of 1,200 yards from it, in a depth of a little over 7 fathoms at ordinary low water, and to have a length of 2,000 yards. This idea was by no means a new one to Madras people, for it was advocated by the late Colonel Haviland, of the Madras Engineers, so long ago as 1836, and repeatedly, by Captain Cotton (afterwards Sir Arthur Cotton, K.C.S.I.), who began a work of that nature near the shore as a shelter merely for boats; but it had remained for Colonel Orr to bring the project forward in a complete form, and of a magnitude suited to the wants of the shipping frequenting Madras, and the Committee, with one exception, entirely agreed with the arguments advanced by him in support of the principle involved in it. The dissenting member was the President, Colonel Carpendale, who considered 2,000 yards an insufficient length for a breakwater lying so far out to sea, and disbelieving the existence of silt in suspension in the sea on that coast, or that the loose sand was conveyed to any considerable distance by the littoral currents, was more in favor of a closed harbour such as had been proposed by Mr. Fraser and Mr. Perkes. He, therefore, advocated the construction of an experimental pier, of rough stone of large dimensions, from a point 300 yards north of the Railway terminus, to a distance of 500 or 600 yards in a direction south-east by south, in order to see to what extent it would arrest the sand.

Though the principle of construction first proposed by Mr. DeClosets, next advocated by Colonel Orr, and adopted by the Committee, was that of the Plymouth breakwater, the conditions of the Madras Roads made it possible to propose a great reduction of sectional area as compared with the area of that work. The principle of construction is to throw into the sea rough blocks of stone just as they are got from the quarry, on the selected alignment, and then allow the mass to take the slopes which the action of the waves gives it. These slopes, Colonel Orr said, were known from experience to be very moderate up to near the level of low water, but from that point upwards to be about 1 in 5. The slopes which the unpitched rubble deposit in the outer breakwater at Portland have finally assumed after years of exposure to the action of the sea, as given by Mr. George Robertson in his report on the proposals for the Madras Harbour to be afterwards noticed, the width at the top being 36 feet, the height 5 feet above high water, the rise of tide 7 feet 6 inches, and the depth of water about 10 fathoms, are as shown in fig. *a* in the annexed Plate. The width of base works out to 311¼ feet.

Fig. *b* is the cross-section of the Plymouth breakwater, as given in Colonel Orr's Report, but the base scales about 407 feet, instead of only 350 feet as stated by him. The rise and fall of tide is 18 feet. The rise and fall of spring tide at Madras is given as 3½ feet in the Admiralty tide tables, but this is said by the local authorities to be a very extreme range, and Colonel Orr and the Committee took it to be only 3 feet, so that the slope of a breakwater there might be much more suddenly steepened than at either Portland or Plymouth harbours. At Portland the natural steep slope begins on the sea face at 135 feet from the edge of the crest, and at Plymouth at about 150 feet. Mr. DeClosets accordingly proposed the next section, fig. *c*, in which the steepening of the outer slope begins at 15 feet below low water mark, but is limited to 1 in 2. The width of base is 243 feet. Colonel Orr, while adopting Mr. DeClosets' proposal for a breakwater of rubble, altered the distribution of the material, or, rather, proposed to attempt to do so, the ultimate shape of the mass being dependent on the action of the waves. His proposed section is shown in fig. *d*.

He says it differs from Mr. DeClosets' only in being suitable for a breakwater in 7 fathoms at low tide instead of at high tide, in having its sea slope carried down to low water instead of to 15 feet below that level, and in having its crest a few feet higher than Mr. DeClosets seems to think necessary. The meaning of this is not clear, for both sections show a depth of 7 fathoms at low water. Colonel Orr's reasons for the alteration were given as follow :—

"It is, no doubt, more in accordance with the experience obtained in other quarters of the world to continue the sea slope several feet below low water; but believing as I do that the sea at Madras cannot acquire the power to act with the disturbing force which it exerts in the more exposed situations where opportunities for noting its effects have been afforded, I am not of opinion that the seaward slope of a breakwater here need be carried further than low water, and I think the material may be better disposed in giving elevation to the crest of the work, to enable it to afford better shelter and smoother water to the anchorage within it."

It will be observed that the width of base is here reduced to 200 feet, and that the inner slope, as in Mr. DeClosets' section, is 1 to 1 throughout. This view of the power of the sea at Madras is most extraordinary, for the situation is as exposed as it is possible to conceive, and cyclonic storms frequently reach the coast. And that it was a most mistaken one was most signally proved when the sea face of the closed harbour which was ultimately adopted was knocked to bits by the sea raised by only a moderately violent cyclone. On that occasion the rubble base on which the concrete blocks of the piers were founded was scoured out from below them in places at a depth of 22 feet below low water mark. Colonel Orr thought that the stones thrown in at random within the space marked out for the breakwater would probably stand at a slope of 45° to near the level of low water, and that from that point upwards the stones, in whatever manner they might be thrown down, would begin to assume for themselves under the action of the waves a long slope to seaward. The sea would arrange them of itself in the manner best adapted to resist its force, and ultimately, after the work had taken a permanent form, its surface might be finished off with a covering of large stones carefully packed on end, as shown in his section. He appears to have thought it possible to fix beforehand the ultimate width of the base of his breakwater—in other words, that during the flattening process no stones would be washed down to a lower level, but all would be washed upwards, and that only the crests of the waves would have effect in doing so. This must be very far from what really takes place, and how such a work is constructed; but we have not space here to go into that question.

The Committee, as we have said, approved of the main principle of the designs of Mr. DeClosets and Colonel Orr, but they decided to continue the exterior slope of 5 to 1 to a depth of 15 feet below low water mark, as proposed by the first-named engineer, and to adopt the greater height above water, and the wall on the crest proposed by the other, but they recommended that this wall should be built on the outer edge of the crest and joining the exterior slope in a curve. This would have added from 40 to 50 feet to the width of the base, supposing the inner slope of 1 to 1 to have stood, and the cross-sectional area would have been 912⅔ square yards or 8,214 square feet. Events have however shown that even that base would have proved insufficient.

The cost of the stone being by far the heaviest item of expenditure, the source of supply had to be considered in framing an estimate for the work, and the comparative advantages of four sources were considered by the Committee, namely, (1) Palaveram, 10 miles from Madras; (2) Sitanagram in the Kistna district, 240 miles distant,

MADRAS HARBOUR

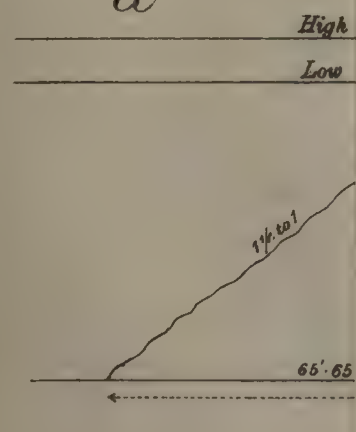
PROPOSED SECTIONS

FOR

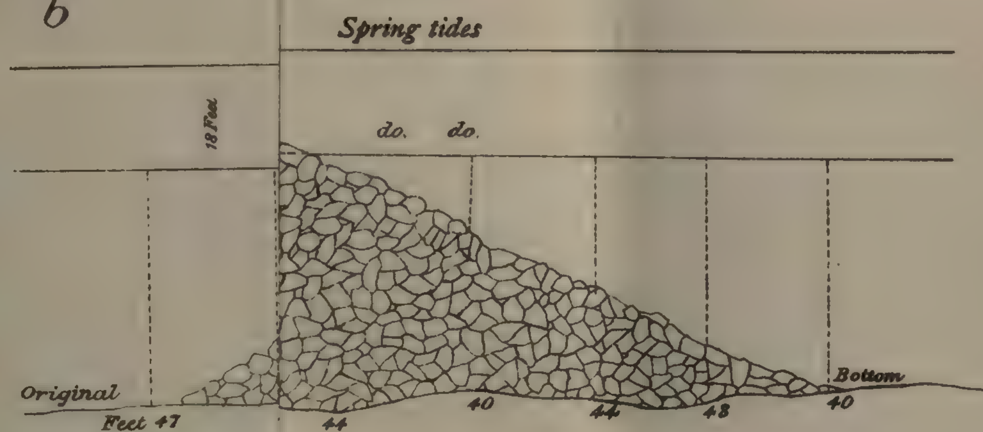
BREAKWATER.

Scale: 33 feet to 1 inch.

a

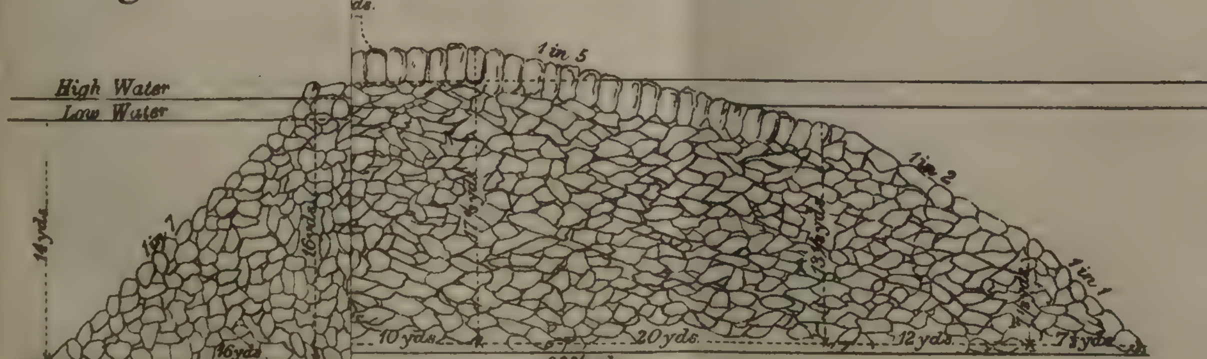


b



COLONEL ORR'S PROPOSAL

c



Sectional Area of rubble— 781¼ yds.

The "STAR" Press, 19 Lall Bazar Street, Calcutta.

but whence the stone could, according to Colonel Orr, be brought direct in barges to the work; (3) Sholinghur on the south-west line of the Madras Railway, 55¾ miles; and (4) Trittany on the north-west line of the same railway, 50½ miles from Madras. The Committee gave the preference to Trittany, because it afforded the necessary supply in a remarkably convenient form for economical quarrying, and because of the superior quickness and certainty of railway carriage. The cost, per cubic yard, of the stone from sites (1), (2), and (4) deposited in place in the breakwater, was estimated respectively at Rs. 4-15-10, Rs. 5-14-0, and Rs. 5-10-0 per cubic yard, taken on the whole cost of the work; and in adopting a comparatively high priced stone the Committee had in view not only that the cost of conveyance by rail from Trittany was a certainty, and from the other quarries very doubtful, but also that the whole cost of carriage, equal to half the amount of the entire estimated expenditure, would, by the employment of the Madras Railway as the means of transporting the material, be in one sense returned to Government, and go to reduce by the amount of profit on that undertaking the Government guarantee for interest.

The following is the abstract of the Committee's estimate of the cost of the work,—including the wall on the crest:—

Abstract Estimate.

1,897,628 cubic yards of stone quarried at Trittany, conveyed by rail to the end of a pier, thence by barges to the site of the breakwater and deposited at Rs. 4-9-6	Rs. 87,17,229
Special additional rate of Re. 1 per cubic yard for one-tenth of the above	1,89,763
Special additional rate of Rs. 10 per cubic yard for the sea-wall	1,33,330
Plant, tools, &c.	2,00,000
Twenty barges at Rs. 4,000	80,000
Four steam tugs at Rs. 50,000	2,00,000
Shipping pier	4,00,000
Superintendence Rs. 3,77,460+2,50,560, say ...	7,00,000
	1,06,20,325

But they do not seem to have been very confident of its sufficiency, for they afterwards remarked that as there was no example of quarrying on the scale that would be necessary for the breakwater in any part of the Madras Presidency extensive operations would be necessary before the actual working rate could be established, and, bearing in mind various contingencies, they thought it not improbable that in practice Rs. 2 per cubic yard would more accurately represent the cost of the stone loaded on trucks at the quarry than Re. 1, the rate assumed in their estimate. And they also thought it very doubtful whether they had correctly estimated the time over which the delivery of the stone would extend. The railway authorities could indeed undertake to deliver 1,000 cubic yards, or 2,000 tons, of stone daily, and, taking 235 working days in the year, at that rate the total quantity ought to be deposited within 8 years after the completion of the shipping pier which would have to be specially constructed; but this involved the ability on the part of the quarry establishment to load that quantity daily. On the whole, the Committee recommended the Government to be prepared for the possibility, if not probability of their estimate being exceeded by perhaps 25 per cent., that is, of the total cost rising to 1⅓ millions sterling. We are not here concerned with the financial part of the project, into which the Committee went very fully, and will only mention that they satisfied themselves that the existing amount of trade would yield, from a rate of one per cent. on the imports and exports, and from port-dues, an income of Rs. 7,28,750, or between 5 and 6 per cent. on the maximum cost of 1⅓ millions sterling. The Committee said nothing about the military part of the question, but in calculating the amount of stone that would be required they allowed for sites of batteries to be erected at each end of the breakwater.

The Government of Madras approved of the report of the Committee in every particular, but without noticing the uncertainty as to the cost of the work. And they resolved to submit the project to the Government of India with a request that the Secretary of State might he moved to send out a thoroughly qualified marine and harbour engineer to examine and report on the feasibility of improving the port by the construction of a breakwater, or in such other way as might appear to be most practicable. In future articles we shall show that the expert sent out by the Secretary of State fully approved of the construction of a breakwater, and endeavour to trace how nevertheless a closed harbour came to be adpoted, with so disastrous a result.

COLOMBO WATER-SUPPLY.

The Maligakanda Reservoir.

The Reservoir in connection with the Water Works of Colombo was observed to crack when being filled in October 1885, since which time they have been repairing it. On the 16th February last they were filling it again, and when the 38 feet level had been attained (*i. e.*, within 1½ feet of being full) other cracks were seen to appear, and the water rushed out in considerable volume,—the torn and jagged channels in the laterite hill side bearing witness to the force of the burst. The sluice was opened to relieve the pressure, but soon a loud explosion followed—meaning total or irretrievable failure.

The Reservoir is constructed of concrete on the top of the Maligakanda hill and was intended to hold 40 feet of water. With this depth the weight to be carried by structure and foundations is—

Walls ...	31-37	cwt.	per.	sq. ft.
Columns ...	39	"	"	"
Floor area ...	22½	"	"	"

The Reservoir is excavated on the top of the hill to a depth of 8 to 16 feet, giving an average of 11½ feet, and the weight of material removed averages 10½ cwt. per sq. ft. of area. The additional loads thus placed on the foundations are—

Walls	20½ to 28½	cwt. per. sq. ft..
Column bases	28½	" "
Floor area	12	" "

When the first accident occurred in October 1885 with 24 ft. 3 in. of water the loads carried due to water were about 9 cwt. per sq. ft. less than above. The hill itself has been carrying its own weight of some 70 to 80 cwt. per sq. ft. for centuries and the material of which it is composed must therefore be capable of distributing that strain. The water was first turned into the Maligakanda Reservoir at the end of September and on the morning of the 16th of October a crack took place in the angle of the S.-E. wall when there was a depth of 24 ft. 3 in. of water inside. On emptying the reservoir an examination showed that besides the break through the S.-E. angle, the N.-E. angle was also slightly cracked on the inside—that the inside floor lining was [illegible]ked along the foot of the E. wall, along the foot [illegible]e benching in front of the S. wall and diagonally [illegible]n places across the S.-E. corner of the reservoir; this la[illegible] area including within it six of the columns supporting the roof. The S. wall and these six columns were, however, untouched and left perfectly sound as well as the remaining 115 columns as also the whole of the rest of the reservoir whose inside area is ⅘th of an acre.

An examination of the gauging shows that for two days previous to the break of the E. wall on 16th October 1885 water had been escaping. This could only have been through the cracks of the floor, and it follows that the soaking of the water under the foot of the wall so far softened the ground that at the end of two days a slight settlement took place which produced the cracks.

These cracks were in no place wider at the lip on the surface than the point of a knife, while in the mass of concrete of both the 12″ floor lining and of the walls they existed as mere lines of fracture without any width or space, thus showing that no sliding or movement of a measurable extent had taken place. Previous to the accident of 16th October 1885 the walls had been standing for 17 months and the columns for 4 to 8 months, with the full loads

upon them without any sign of weakness or settlement. Since that accident they have been standing (as tested by measurement and levels) without alteration for a further term of 16 months, although the E. wall had been cracked in the angles.

It is therefore evident that the ground is not in itself liable to subsidence or compression under these loads. The foundations were thus carrying a load 2½ times greater than that on the floor lining when the failure took place. The cracks and splits in the floor lining started in the angle of the lining at the foot of the benching, 9 ft. in front of the S. side wall at or near the junction angle with the E. wall, and it is probable, says Mr. A. W Burnett, the Resident Engineer, that the cross strains at this angle brought into action by the pressure of the water started the failure in the lining.

The repairs proposed to remedy the damage consisted of

(A) the repair of the E. wall.

(B) „ „ „ „ flooring.

(C) „ „ „ „ „ and strengthening of the junction between floor and wall.

(D) the strengthening of the corners of the reservoir by rounding or filling in the angles.

This work was commenced in May and finished in November last and the water again turned in on 15th December, but the reservoir was emptied again in consequence of irregularities appearing in the gauging. On examining the inside horizontal lines hair cracks or strains were found in the cement facing of the curved concrete footings to the E. N. and W. walls and a line of crack or fracture in the same position along the S. side, the strain and cracks being from 2 to 4 feet in front of the face of the wall and the same height above the floor. The crack along the footing of the S. wall was deflected off by the rounded angles of the reservoir at each end and thrown upwards and across the angles for about two-thirds of the height. The horizontal lines of strain on the other walls were thrown out altogether at the rounded angles of the reservoir with the exception of one side of the N. W. angle where just the faintest indication of strain was visible from 5 to 6 feet in height.

The whole of the rest of the reservoir was quite sound.

Referring to the works of repair (A) and (B) are thus successful. The repair (D) of the E. wall, including the delicate operation of cutting through the wall 35 ft. high and 25 ft. thick with the under cutting and under pinning and making it good with new concrete, could not have been accomplished if there had existed any defect in the original work on the foundation on which it is placed, and is in itself no inconsiderable feat to those who may appreciate the difficulties and risks attending such an operation.

The whole of the floor area (B) ⅞th of an acre is now perfectly sound and good as are also the columns and arching.

It is in the curved footings and junction between floor and walls that the present strain has taken effect, showing most along the S. side towards the level ground and least along the E. side where the wall was before broken. The filling of the corner angles has thrown out the strain in the footings of the walls adjoining them. Three of the four objects in view in the late repairs have thus been obtained.

The strains shewn in the footings have now been traced out. Nearly the whole of these affect only the neat cement facing from ⅛" inch to ¾" inch in depth, the concrete below being untouched.

In some few places, and on the S. side to a greater extent than elsewhere, the lining up of the concrete under the cement facing has been affected with the cement, the greatest extent being from 2 to 3 inches in depth, the solid bulk below being as far as it is possible to tell perfectly sound and untouched, no trace of crack or fracture can be found. The loss of water which took place when 30 feet depth was reached was thus due to percolation into the bulk of the concrete and possibly through it—owing to the great pressure after the sudden fracture of the rigid cement facing.

The effect of the strain has occurred just at the point in the carved footing where the change from vertical to horizontal pressure is most acute and is partly due to the self-contained strain in the rigid cement facing and partly by the tension caused by the lowering of the temperature internally through the cooling effect of the water. The cracks would thus be due to the cross pressure of the water on the cement skin already in strain in itself and the rigid cement would break while the mass of concrete would be able to meet and distribute the strain without fracture.

With the exception of this surface strain in the footings the whole work is perfectly sound. The walls and columns have been carrying their load for some 2 to 2½ years and the floor area inside has been tested at the column bases on 121 equidistant areas of 28 sq. feet each with loads from 40 to more than 50 per cent. greater than it will have to bear with the full depth of water to meet the surface strain in the rigid cement facing of the footings. The area on which the strain has developed was lined over with asphalte. In laying the asphalte Mr. Burnett proposed to groove out the horizontal line of strain and two paralell ones above and below so as to cut off and break up the continuous face strains in the cement and to allow of the slight self adjustment shown to be necessary to take place between the hollow grooves. At the same time these grooves act as ties to hold the concrete.

The capacity of tne Reservoir as at first designed was 8,500,000 gallons; as first completed 8,900,000; and as it is now 8,600,000.

Cost.	Rs.
Purchase of Maligahakanda Estate, 24¾ acres, Rs. 70,000, 3½ acres Required...	10,000
Cost of works up to October 1885 ...	347,128
„ repairs and sundries to December 1886	68,726
„ repairs now in hand ...	2,200
Total ...	4,28,054

F. W. Thomson, B.E., M.I.C.E.I.

THE LIVING EARTH;

(Continued from last issue.)

A Lecture delivered at Dacca,

By A. Ewbank.

As another illustration of the life that dwells in nature, let us briefly consider earthquakes. The peculiar terror of an earthquake lies mainly in the suddenness of its approach. Volcanic eruptions are usually preceded by vast rumblings, or jets of steam or other unmistakeable tokens. Hurricanes and cyclones in like manner have heralds that announce their coming. But with an earthquake there are no premonitory symptoms. The great earthquake which took place at Lisbon in the year 1755, found the people engaged in their ordinary occupations. All the shocks were over in about five minutes. The first shock lasted about six seconds. In that briet space of time most of the houses had been thrown down and thousands of men, women and children crushed beneath the ruins. At times the ocean lends fresh terrors to the scene. Thus at Lisbon a wave of water over fifty feet high rushed in among the houses and covered what still remained. In the Island of Jamaica on a different occasion two thousand five hundred houses were buried in three minutes under thirty feet of water. Recent delicate scientific experiments have discovered the fact that the surface of the land is never absolutely at rest for more than thirty hours at a time. Thus those great earthquakes which make epochs in history are merely extreme cases of forces that seldom sleep.

It might perhaps be thought that those earthquake waves, such as that which passed over Dacca less than a

year ago, are merely temporary in their nature—that they are like the billows of the sea which when they have presently come to rest have left no change of level. Usually however these earth tremblings do seem connected with changes of level. About a hundred and thirty years ago it occurred to a Swedish astronomer named Celsius to examine the truth of a common belief that the waters of the Baltic Sea were gradually diminishing. Old men pointed out to him places over which in their childhood the sea used to flow, but which at the time of the inquiry were never reached by the waters. How was the point to be examined? Clearly all that was necessary was to mark upon sand or cliff the present level of the waves. This he did, and by watching for about fifteen years, he was enabled to shew that the waters were sinking at the rate of one yard in every hundred years. You will understand that if a cliff stands vertically in the water one fresh yard of its surface would in that case become exposed. On the other hand, a sloping shore would be uncovered to a greater distance according to the slightness of the slope. For example, a moderate and not unusual slope might yield fifty yards of fresh coast. When the Swedish astronomer had thus definitely ascertained a change of level he began to reason upon his observations. The Baltic Sea has free and open communication with the North Sea and the English Channel and thus with the Atlantic and Pacific Oceans. If, therefore, the waters of the Baltic had simply suffered diminution—as by example from evaporation—it is clear that a fresh influx of water from those seas and oceans would cause a readjustment of the level. As the total mass of water on the earth is practically constant we should not expect permanent alterations of the level in any bay or gulf. How then should we explain the undoubted fact that the level of the coast line of the Baltic was actually changing? Simply by the fact that the land was rising and not the waters sinking.

When matters had reached this interesting stage the Swedish clergy rushed in and endeavoured to stifle the inquiry. They argued that such movements of the earth's surface were nowhere admitted in certain writings which regulated their religious belief. They therefore accused the Swedish astronomer of gross impiety to heaven. The matter was brought by them under the notice of the Swedish Parliament with a view to obtain his condemnation and punishment. The clergy had their representatives in this Parliament and they worked, moreover, on the superstitious fears of the more ignorant of the people. But as it happened there was still some sanity left among the population. The Parliament by an overwhelming majority declared itself unfit to control the investigations of science. The annoyance to the Swedish astronomer being thus declared not only absurd but illegal, his investigations could be resumed. Then it was found that the whole peninsula of Norway and Sweden was in slow but constant motion. It was in fact turning about a line in its surface, so that while one part was rising out of the water another was gradually being submerged.

Finally, it has been found that similar changes have occurred and are occurring in different parts of the world. Thus England in a far past was joined to the continent of Europe. In like manner the countries round the Mediterranean have suffered entensive changes. Towns which originally were built on the coast have been left far inland. Slow indeed may be these changes, but are they the less mighty? As the violent spasmodic action of a volcano is to the never-resting forces which are bearing our mountains to the sea, so the terrible changes wrought by earthquakes dwindle into insignificance compared with those other and wide-spread energies which lift this earth on which we tread, slowly from the bosom of the deep.

On one result of these changes we may for a moment dwell. The Mississippi—the "father of waters—" takes its course from north to south. Like all rivers it is just so much water running down hill. If now the surface of the hill is slowly rotated as the motion of my hand represents, it follows as a natural consequence that the direction of the current will be changed. If the western part of its neighbourhood is rising while the eastern neighbourhood is sinking, it seems that the river by little and little will shift its course to the east. Such in fact is the movement of the country drained by the Mississippi and the great river alters its course in the manner that theory prescribes.

Another very interesting change in the channel of a river must not be left unnoticed. Let us suppose that a large globe made of wood or of any other material is so poised as to be capable of spinning about its vertical diameter. The summit of this globe we may call its north pole and its lowest point we may call the south pole. Thus a slow rotation about the vertical diameter represents that spinning motion of our earth which gives us one day and one night. As we stand looking at the globe slowly revolving, let the motion be such that any particular point on the surface comes into sight on our left hand and after describing a portion of a circle disappears on the right hand owing to the globe being opaque. Let us define this direction of the motion by saying that each point on the surface of the globe is carried eastwards by the spin. Let the motion of the globe be now stopped. Let us pour water in a very thin stream, or in discontinuous drops which do not rapidly follow each other. Let each drop fall on one and the same point of the globe's surface. Let this point be near the north pole, but not exactly at it. Each drop will commence to move down the surface and the line taken by one drop will be exactly the same as that taken by any other drop. Each drop therefore adds itself to its predecessors and a thin stream which we will call a river, trickles down towards the equator. This river moves in what we call a meridian, or we may say that its course is always due south. After the drops have fallen for some considerable time, we may suppose that the river has worn for itself a regular and visible channel, cut out of the surface of the globe. The channel being thus established and being so deep that the surface of the water in it is slightly lower than the surface of the globe on either side, let us give again to the globe that same revolving motion from West to East, which it had formerly. There will be a tendency for the water in the river to desert its already cut channel. It will tend to leave the channel and travel westwards. In other words it will tend to be left behind by the revolving globe. The channel being a part, so to say, of the solid globe will move with it. The water not being actually fastened to the solid globe tends to keep its original movement, which was downwards and which was not to the left or right. In keeping such truly downward motion it would seem by comparison with the channel and the banks of the river to be trying to move westwards. Instead of pressing on the sides or banks with equal force as it did when the globe was at rest, it will now press on the west bank more strongly than on the east bank. The consequence is that it will gradually cut into this bank. As it cuts into this bank, it will gradually desert its old east bank, and if we suppose this process continued for a very long time and then the drops of water discontinued and the globe brought to rest, we can examine the nature of the new channel. Instead of being a meridian circle of the globe, it will now shew a curved line, which continually has a direction west of due South. A man or an insect walking down this channel is always changing longitude.

Now the earth has a constant rotation about its polar axis. There are rivers which in part of their course run nearly due south. They have in past times cut into the beds in which they at present are moving. Such a river when it is running due south and is in the northern hemisphere, behaves in just such a way as our wooden globe illustrated. The western bank—called the right bank by a man who is going down stream—is gradually undermined by the increased water pressure. The soil thus falling into the river and

that material which from other agencies is brought into the water, may partly settle in the eastern (or left) bank, which the waters are gradually deserting. Thus by slow degrees the bed of the river is, as it were, laterally shifted. This cutting into the west bank tends to make the bank precipitous, *i.e.*, to make the water deep close into the west side. The eastern bank having once been in mid-channel, and having only received deposits from the soil carried in suspension by the current, is naturally low and nearly level. When therefore by heavy rains or other causes the volume of the waters in the river is, for the time, greatly increased, the river easily resumes its sway over its old domain. Thus it is not desirable to build houses on the low-lying east bank. On the other hand, if houses are built close to the river on the west bank (where the water is deep and therefore is convenient for commerce), the foundations of the houses are gradually undermined, and inch by inch these houses are claimed by the ever-advancing waters.

Similar, but not identical, results are seen when a river in the northern hemisphere runs due north, or when in the southern hemisphere it runs due north or due south. The mathematician readily brings the four cases under the operation of one general law and he understands that even where the course of a river is not exactly north or exactly south corresponding effects must still follow, although in a less degree.

Thus in Europe the river Volga during the last two hundred years has notably changed its course. In that time—comparatively short if we think of the whole age of the earth—the great river has successively hollowed out for itself fresh beds tending more and more to the west. Twenty-three towns which, in ignorance of this law of rivers, had been built on its western bank have been slowly demolished house by house and street by street. Similar changes have been noticed in the Danube. In Persia the Euphrates, and in this country the Indus exemplify the the same great law.

There are rivers that divide, as it were, their existence between the day and the night. For part of their course they flow on the surface of the earth and render service to man. They then disappear in some abyss to continue their journey where man may never follow. Occasionally however they appear once more and thus permit their subterraneous travels to become the subject of inquiry. Thus in France a stream called the Bandiat pours its waters into several abysses. By-and-by the waters issue again; flowing slowly out of a deep cave beneath a vertical cliff. When the waters are thus reunited the stream takes a new name—the Touvre—and it flows into a stream called the Charente.

When a subterranean stream makes its first appearance at the surface of the earth we give it the name of a spring. Springs are often described as being the sources of rivers. But when we follow up a river to what we call its source, its birthplace is not reached. For mile after mile in utter darkness it has followed its winding path and the spring is but that bend in its course which lifts it to the light of day.

Such a spring may collect tribute from many hundreds of square miles and at times it may pour forth such a volume of water as flows past London or Paris. But though few springs attain to such dimensions and though most indeed are small, they are not the less lovely. In the Himalayas we are struck with a massive sublimity as we gaze on those giants of the earth. But in the tiny fountain there dwells a tender attractiveness—a most delicate beauty.

Welling up in some quiet valley it flows rippling through a meadow of verdure, to which its own presence brings life. Need we wonder if the Greeks—those poets of the world—have discovered in some slight rivulet, a nymph engaged in bathing flowers meant for the garland of a Goddess? Or if another rivulet springing from the mountain side glances brightly in the sunshine, as it takes a leap to the valley below, is it not successfully escaping from those overhanging rocks that strive to overwhelm it? If we ask ourselves why in the presence of a tiny fountain we are touched with so tender an interest—it may be from the mystery of its birth. It comes to us a whispered message from the hidden life in nature. Of that life we also are partakers, and what is all life but a mystery?

My task is ended. I have brought before you some of the features of this the Living Earth. Others not less wonderful remain untold. Some of them would need a more technical treatment than is suited to the present audience. Those features which I have chosen, it has been my endeavour to make at once intelligible and attractive. I remember that when I was a schoolboy there was nothing that I hated so much as a lesson in Geography. But Geography in those days was more repulsive than at present. Possibly, gentlemen, some of you used to feel exactly as I did. And when you entered the room this evening and saw all these maps on the walls you felt yourselves once more in the presence of an instrument of torture, from which at the time of your leaving school you thought you had for ever escaped. It was then with gloomy anticipations that you submitted to the lecture. May I venture in this case to express a hope that your worst fears have not been realised?

[This lecture is here published for the first time, though it was delivered about ten years ago to a Literary Society in Dacca. For the arrangement and presentation of the subject the lecturer is responsible. But the mere facts may be found in most large works on Physical Geography. The best studies in this subject are found in the writings of M. Elisée Reclus.—A. E.]

MYSORE PROVINCE.

(Expressly for Indian Engineering.)

Some information regarding Public Works in Mysore—which, since the recent visit of Lord Dufferin, is looked upon as the model Native State—will not be out of place in the columns of your *Journal*, which is looked up to in these parts as an authority on Professionel matters, and will give your readers an idea of how things are carried out in Mysore. During the current official year—1886-87—the sum total sanctioned for Provincial and District Roads is Rs. 4,16,950. The length of the class called "Provincial" roads is 1,068 miles, and the rate allowed for maintenance and up-keep varies from Rs. 84 to Rs. 337 per mile per annum. The "District" roads total a length of 3,600 miles, and the average rate for up-keep is Rs. 58. Considering the lowness of this figure it is creditable to the Department that the District roads are in such good condition; but labour and material are cheap. No *kunker* is used on the District roads, the principal material is gravel which can be had in most parts along the side of the road and forms a very good crust for fair weather traffic.

For Irrigation works the total grant allotted is Rs. 5,10,800, and it is not improbable that this figure will be exceeded, as during the year increased attention has been given to the restoration of tanks and channels, the improvement of others, and to commencement of new projects. Mysore being purely an agricultural province its revenue is mainly dependant on the facilities offered to the ryots for cultivation, and as the water-supply for rice, sugarcane, &c., is dependant on the storage capacity of the numerous tanks scattered all over, it behoves the D. P. W. to see that the tanks are in good order and otherwise brought up to a standard of safety. It is curious to note here that in the early part of the century, under the regency of the Dewan Puruya—a name still venerated in Mysore—a sum of 31½ lacs was devoted to irrigation works, and the greater part of this was absorbed in the repair of old tanks and channels, the majority of which had fallen into a ruinous condition during the reigns of Hyder and Tippoo. The remains of a canal—known as Puruya's nullah—are to be seen and traced to this day at Mysore. The object of this canal—on which upwards of 15 lacs of rupees were spent—was to convey the holy waters of the Kaveri into Mysore and thence to Nangengode, where there is a famous Hindu temple and several holy shrines; but it failed in its intention and the canal was never finished. The idea, however, of bringing the Kaveri water into Mysore has recently been revived, and with modern thoughts to bear on the subject it has been ascertained that the project is very feasible, though it will be carried out on different lines to those laid down by Puruya (who, by the way, scorned the idea of an Engineer),

and it is not unlikely that a channel will be made from a point some miles higher up the river than that from which Puruya's channel took its departure, by which a greater fall per mile will be obtained, and the water conveyed into the Kookerhully reservoir, near the City of Mysore, and thence distributed by pipes throughout the city. The Kookerhully reservoir it may be mentioned was constructed by the D. P. W. about 5 or 6 years ago with a view to act as a reserve for the water-supply of Mysore, but sad to say the water could not be found to store in it. It is therefore twin-brother to the reservoir known as "Sankey's Folly" at Bangalore; both projects being designed by the same Royal Engineer officer, and five lacs sunk on each.

One of the heaviest Irrigation works taken in hand this year is the Rampur channel, which is to cost Rs. 2,30,000. This is under charge of Mr. G. H. Bayley, C.E—an Engineer of much provincial experience and who, if justice had been done, ought now to be at the head of the Mysore D. P. W. The whole of the work was given out on contract and it is expected to be completed in three years. Several thousands of acres of arable land will be irrigated by water from the Rampur channel.

Since the transfer of the Mysore State Railway to the S. M. Railway Company in July last, the public have been looking forward to the completion of the link from Goobee to Hurryhar, where the junction with the Southern Mahratta system will be effected, and through communication with Western India and the Deccan established. But evidently the Company is not in a hurry, and though plans, surveys, &c., have all been made out and sanctioned nothing has been done on construction. Had the Mysore State retained control it was intended that the first section of 30 miles from Goobee to Tiptur should have been put in hand last October, and would ere this have been well forward. The S. M. Company took objection after the transfer of the Mysore State Railway to the route selected for the line and demurred at the same, but the Durbar refused to allow the line to be deviated from; very properly pointing out that the route was selected after several trial surveys and adopted under the advice of Engineers who were fully acquainted with the resources and needs of the Province and therefore better qualified to judge of the laying down of the route within Mysore than any of the staff of the S. M. Company, who could not lay claim to any knowledge of the country. Besides the route had received the sanction of the Government of India, and in the preliminaries of transfer was accepted by the S. M. Company, so that the Durbar insisted on its being carried out. Large quantities of stores are being received here for the extension, but it does seem strange that such a favourable working season should be allowed to pass over without a sod being turned or a pick put in the ground.

BANGALORE; 26*th February* 1887. T. T. L.

NOTES FROM HOME.

(*From Our Own Correspondent.*)

UPON the completion of the works that have lately been carried out for the improvement of the drainage at the Houses of Parliament I had recently an opportunity of inspecting what had been done. Mr. Shone has very successfully adopted his system here to overcome the difficulties that previously existed of an insufficient fall. The sewage is now caused to gravitate to a chamber built under the plot of grass between the Houses of Parliament and Westminster Bridge and which is known as "The Speaker's Green." Three ejectors are placed in this chamber, two of which are of a capacity of 350 gallons and one of 500 gallons. One of these of 350 gallons was, at the occasion of my visit, dealing with the dry weather flow of the Houses of Parliament, and it is calculated that the combined power of the three ejectors will be amply sufficient to deal with the maximum storm flow. The sewage is by this means lifted about six feet and is discharged under a pressure of about 11lbs. on the square inch into the higher level sewer, instead of the low level sewer as formerly. I need not here enter into the details of the system, as a very full illustrated description is given in last Saturday's *Builder* and an account also appears in last weeks *Iron*, to which I refer your readers' attention. I have only to add that the work was being done automatically, noiselessly and to all appearances satisfactorily.

The ordinary meeting of the Institution of Civil Engineers, held on the 8th February, was occupied in a discussion following upon the paper on the Disposal of Sewage Sludge. The principal speaker was Dr. Tidy, who directed his remarks to the proposed works about to be carried out by the Metropolitan Board of Works at the Northern Outfall at Barking, severely criticizing the process as chemically inefficient and likely to prove an expensive failure. On the other hand, Dr. Dupré defended what was going to be done, urging that the Metropolitan Board of Works was not wedded to any particular chemical agents and if the proposed deodorisers were found to be insufficient or ineffectual, they could be added to or varied or others could with facility replace them. The discussion was further adjourned, and judging from the interest evinced in the subject, I doubt whether another meeting will exhaust all that is going to be said upon it.

While the nations on the Continent are vying with each other in the race of armaments, the authorities here are on the *qui vive.* As a result of the Committee presided over by Sir Evelyn Wood, which recently met at the War Office to report upon a repeating rifle, which had been submitted to the military authorities, orders were recently given for experiments to be made with the weapon on at as early a date as possible by selected men of eighteen infantry battalions at home stations. I also note that the first 110-ton gun—the heaviest weapon ever made in England—was a day or two ago safely conveyed to the proof butts at Woolwich Arsenal, to undergo its preliminary trials. After these have been made the great gun will be conveyed to Shoeburyness for sighting experiments at the long ranges.

At a meeting of the Society of Telegraph Engineers and Electricians, on the 27th January, a paper was read on "Telephonic Investigations" by Professor Selvanus Thompson, in which the author pointed out that the development of telephonic discoveries, together with the adoption of the exchange system essentially laid between the years 1875 and 1879; but that there still exists a need for more reliable instruments and for those that will work over longer distances. The author then gives at length the results of his investigations relating to transmitters, transformers and receivers, of his experiments to find a pair of materials, which when used as the contact surfaces of a transmitter should give better results than the ordinary contact of platinum against carbon. The author illustrated his paper by examples and diagrams and concluded his paper by reiterating his conviction that the success of long range telephony depends upon the possibility of devising instruments of higher battery power, and such as are adapted to receive stronger currents than the present receivers with a higher electrical and mechanical efficiency.

Anent this subject a telegram, dated Paris, 2nd February says:—"This afternoon President Grévy conversed by telephone with the King of the Belgians, direct communication having been established between the Elysée and the Royal Palace at Brussels."

A novel feature in drainage works presents itself in the works now in progress near Newcastle on-Tyne, in the vicinity of the Ouseburn Viaduct. A heavy drift has just been made at the foot of the hill right up to the vicinity of the bridge; and as the hill is very steep the task of timbering has been difficult. Earthenware pipes formerly carried the sewage down the slope; but in the plans for the new work, Mr. Laws, the City Engineer, provides masonry to take the place of the earthenware. Broad stone steps are to be laid from the bottom of the hill to the top, and a brick arch is to be formed over these. The sewage then, flowing from the ordinary sewer at the head of the bank, will enter the archway under cover and will flow over the stone steps rapidly down the hillside, and into the Ouseburn, near Byker Bank. This is the first time that the system has been tried here; and as it will allow of an immense sweep of water in times of exceptional wet weather without the usual danger of pipes choking, it is expected to work satisfactorily.

The Association of Municipal Engineers notify that their next examination of candidates for the offices of Municipal Engineer and Local Board Surveyor is to take place in London next April. This Association, which now includes the principal Municipal Engineers of the Kingdom, is about 13 years old, and has been doing quiet but important work towards improving and protecting the interests of its members. Foreign members are by its rules eligible to join its ranks and its advantages may be recommended to those of your readers who have charge of towns in India. The Proceedings of the Association are, I understand, highly appreciated by Engineers and Surveyors of Continental towns; and the Association's examinations are growing in favour as the value of its certificate of competency is becoming almost a necessity to those seeking the office.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, March 5, 1887.

Mr. H. Johnson, Superintending Engineer, 3rd class, temporary rank, Engineer-in-Chief, Bilaspur-Etawah Railway, is granted furlough for seven months, with effect from the 8th April 1887, or any subsequent date on which he may avail himself of the same.

Mr. W. C. L. Floyd, Executive Engineer, 2nd grade, Deputy Consulting Engineer to the Government of India for Guaranteed Railways, Calcutta, has been granted by Her Majesty's Secretary of State for India seven months' extraordinary leave, without pay, in extension of the furlough granted him on 23rd February 1886.

Lieutenant Eyre Houston, R.E., is permanently appointed to the Department as an Assistant Engineer, 2nd grade, and posted to Hyderabad.

Colonel W. Jeffreys, R.E., Superintending Engineer, 1st class, North-Western Provinces and Oudh, is appointed to officiate as Chief Engineer and Joint Secretary to that Government in the Irrigation Branch, during the absence on furlough of Colonel J. G. Forbes, R.E., or until further orders. While so officiating, Colonel Jeffreys will hold the temporary rank of a Chief Engineer, 3rd class.

Military Works Department.

Lieutenant A. D. G. Shelley, R.E., Assistant Engineer, 2nd grade, held charge of the current duties of the Office of the Executive Engineer, Sibi Division, Military Works, in addition to his own duties, from the forenoon of 19th October 1886 to the afternoon of 18th November 1886, during the absence on privilege leave of Captain J. G. Day, R. E., Executive Engineer.

Director-General of Railways.

Mr. T. W. Grant, Executive Engineer, 2nd grade, is granted, furlough for nine months, with the usual subsidiary leave, with effect from 22nd March 1887, or such subsequent date as he may be permitted to avail himself of the same.

Mr. A. S. Gerrard, Executive Engineer, 2nd grade, is, on return from furlough, posted to the Cuddapah-Nellore State Railway Director-General of Railways' Notification dated 4th February 1887, is hereby cancelled.

Mr. C. S. Harris, class IV., State Railway Superior Revenue Establishment, Stores Department, is, in the interest of the public service, transferred from the Sind-Sagar State Railway to the Sind-Pishin State Railway.

N.-W. Provinces and Oudh, March 5, 1887.

Buildings and Roads Branch.

Mr. J. W. L. Tozza, Assistant Engineer, 1st grade, passed the Departmental Standard Examination in Hindustani, on the 22nd February 1887.

Railway Branch.

Mr. E. L. Hunt, Executive Engineer, 1st grade, sub. *pro tem.*, Hardwar-Dehra Railway Survey, is granted nineteen months' furlough out of India, with effect from 9th April 1887, or such other date as he may avail himself of the same. The usual preparatory leave is also granted.

Irrigation Branch.

Mr. J. R. C. Nicolls, Executive Engineer, 4th grade, temporary rank, Narora Division, Lower Ganges Canal, is granted furlough out of India for 10 months, with the usual subsidiary leave.

With reference to Notification dated 21st January 1887, transferring him to the 2nd Circle, Irrigation Works, Mr. W. B. Gordon, Assistant Engineer, 1st grade, is posted to the Nadrai Aqueduct Division, Lower Ganges Canal.

Mr. H. J. Strickland, Assistant Engineer, 1st grade, Etawah Division, Lower Ganges Canal, passed the Lower Standard Examination in Hindustani on the 6th July 1885.

Madras, March 2, 1887.

Mr. A. Joyce, Executive Engineer, 3rd grade, from the Tank Maintenance Scheme to the V. Circle for charge of the Public Works Stores and Workshops.—To join at the public expense.

M. R. Ry. S., Rai Bahadur Subharayachariar Avargal, B.C. E., Executive Engineer, 4th grade, from the Tank Maintenance Scheme to the IV. Circle for charge of the Coimbatore Division.—To join at the public expense.

Mr. G. E. Manson, Executive Engineer, 4th grade, temporary rank, will hold charge of the Negapatam Division in addition to the special duty on which he is at present employed.

Mr. A. A. G. Malet, Executive Engineer, 4th grade, temporary rank, will hold charge of the Nellore Division in addition to the Sangam Project Division.

Mr. W. Hughes, B.A., Executive Engineer, 2nd grade, is granted furlough in India on medical certificate for three months from or after the 8th February 1887.

Bengal, March 9, 1887.

Establishment. General.

Baboo Barodia Prosad Bosu, Executive Engineer, 4th grade, sub. *pro tem.*, lately attached to the Rajshahye Division, is granted sick leave for seven months from the 6th August 1886.

Establishment.—Irrigation.

Mr. H. E. Pellereau, Assistant Engineer, 2nd grade, is transferred in the interests of the public service from the Balasore to the Cossye Division, *vice* Mr. C. H. DeMello, Assistant Engineer, about to proceed on furlough. This cancels Notification of the 1st instant, transferring Mr. O. C. Lees to the Cossye Division.

Punjab, March 3, 1887.

Mr. W. Macdonald, Executive Engineer, to the charge of the Patiala-Bhatinda Railway Survey.

Mr. J. G. Davis, Assistant Engineer, 1st grade, has passed the Departmental Standard Examination in Hindustani.

Mr. B. Parkes, Executive Engineer 2nd grade, sub. *pro tem.* Bannu Bde. Division, is allowed furlough for 20 months.

Mr. J. K. E. Verschoyle, Assistant Engineer, 1st grade, Swat River Canal Division, has passed the Departmental Standard Examination.

Mr. W. P. Brodie, Executive Engineer, 2nd grade, 1st Division Bari Doab Canal, is allowed 18 months' furlough to Europe.

Burmah, February 26, 1887.

Mr. R. Ring, Executive Engineer, 1st grade, Rangoon Division, is granted one year's furlough to Europe, with effect from the 20th March 1887, or such subsequent date as the leave may be availed of. Subsidiary leave for ten days is also granted, with effect from the 10th March 1887, or subsequent date.

Central Provinces, March 5, 1887.

Mr. J. B. Chirnside, Assistant Engineer, Wardha Coal State Railway, availed himself, from the forenoon of the 16th ultimo, of the privilege leave granted to him in Notification, dated the 4th idem.

Three months' privilege leave is granted to Mr. G. G. White, Executive Engineer, Hoshangabad Division, with effect from the date on which he is relieved.

Mr. C. O. Leefe, Executive Engineer, 4th grade, temporary, is transferred from the Chief Engineer's Office to the charge of the Hoshangabad Division.

Mr. C. O. Leefe, Executive Engineer, was relieved of his duties in the Chief Engineer's Office on the afternoon of the 17th ultimo.

Notices.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Obituary.

HANCOCK.—On the 9th March, at Calcutta, Major-General Henry Francis Hancock, Royal Engineers, Secretary to the Government of India, Public Works Department, aged 53 years.

PATTISON.—On the 2nd March, at Calcutta, W. Pattison, Mining Engineer, of Burrakur, aged 37 years.

McDOWELL.—At Umballa, on the 2nd March, A. S. F. McDowell, Public Works Department, aged 37 years.

WILSON.—At Saharunpore, on the 25th February, of heart disease, W. D. Wilson, late Permanent Way Inspector, O. R. Railway, aged 54 years.

FENWICK.—At Calcutta, on the 14th March, Horace B. Fenwick, Assistant Engineer, Waterworks, Calcutta Municipality, aged 46 years.

INDIAN ENGINEERING.

SATURDAY, MARCH 19, 1887.

IRRIGATION WORKS, N.-W. P. AND OUDH, 1885-86.

IN the *N.-W. P. and Oudh Gazette* of the 26th February an able minute is recorded by His Honor the Lieutenant-Governor on the working of the Irrigation Branch of the Public Works Department for 1885-86.

It appears that the total mileage maintained was—

	Miles.
Main Canal	1,445
Navigation Channels	44
Escapes	107
Distributaries	6,243
Drainage Cuts	1,558
Total ...	9,397

The total gross assessment was ...	Rs. 60,33,016

The expenses were—

	Rs.
Working expenses	24,88,393
Interest on capital	26,75,204
Total ...	51,63,597
The clear profit was therefore ...	8,69,419

The outlay on construction under all heads up to the end of 1885-86 was Rs. 7,51,49,595.

The amount of clear profit therefore after paying working expenses and interest on capital was 1·15 per cent.

In calculating the percentage of profit, however, the Joint Secretary for Irrigation has, *why* is not clear, ignored the interest charges and he computes the net profits to be 4·72 per cent. on the capital.

The Government resolution also gives a table of the percentage of net profits to capital for the last 10 years as follows:—

1875-76	6·08 per cent.
1876-77	6·13 "
1877-78	7·26 "
1878-79	8·57 "
1879-80	6·09 "
1880-81	5·48 "
1881-82	6·17 "
1882-83	6·26 "
1883-84	7·33 "
1884-85	4·45 "
1885-86	4·72 "

From which it appears that the canals are now yielding little more than half the revenue (in proportion to outlay) that they were doing in 1878-79; but in judging of the above figures it should be remembered that the percentages given do not take the interest on capital into account.

The total area irrigated was—

	Acres.
Rabi (October to March)... ...	1,007,417
Kharif (April to September) ...	702,259
Total ...	1,709,676

which gives 222·3 acres per mile of canal open (excluding navigation channels, escapes, and drainage cuts).

The irrigation was provided to 8,274 villages by 35,817 outlets, and the total value of the crops raised by canal water was Rs. 4,97,91,920.

In the year 1880-81 the area irrigated was 1,732,696 acres, but the length of canal then open is not given. It is however clear that the area irrigated in 1885-86 is rather less than that supplied with water five years ago, although the capital expended between those dates is shown to be Rs. 1,05,87,879;—to be sure something may be urged as regards the difference of seasons, which must of course affect the demand for water, making it difficult to fairly institute a comparison—but such a large difference can hardly be so accounted for satisfactorily to the ordinary mind.

The following is the detail of the various crops irrigated:—

		Acres.
Kharif ...	Sugarcane	175,944
	Rice	100,706
	Indigo	297,314
	Cotton	60,580
Rabi ...	Wheat	550,000
	Barley	118,000
	Gram	42,087
	Poppy	15,629

The duty of water on various canals was as follows, per cubic foot:—

	Area irrigated. Acres.	Value. Rs.
Upper Ganges Canal ...	216	578
Lower " " ...	138	320
Agra Canal ...	170	403
Eastern Jumna ...	208	622

As regards navigation, the gross revenue was shown to be Rs. 25,700 and the working expenses Rs. 37,245—giving a loss of Rs. 11,898, which is not satisfactory as there has been a deficit in former years also, and attention might be given to details of this work with advantage; but if it is found impossible to obtain enhanced rates on carriage or to reduce expenses, the sooner the navigation on these canals is stopped the better.

On the whole, it can hardly be said that the canal system of the N.-W. P. is *commercially* a paying one, although the *indirect* return in the prosperity and well being of the country, and in the partial protection against bad seasons which these canals afford, would fully justify the expenditure incurred—even if there were no profit whatever in hard cash.

BATTLE OF THE MAIN.

I.

If there is one thing more than another which is a distinguishing characteristic of the debates of the Calcutta Civic Fathers, it is the warmth of their discussions, which increases in direct ratio to the general ignorance prevailing of the subject under consideration. This remark finds an apt illustration in the proceedings of a meeting of the Municipal Corporation held, not long ago, in regard to the question of the new 48-inch main, or what is now known as 'Battle of the Main.' It might very well be supposed that those whose knowledge of technicalities was circumscribed within the narrowest limits would have discreetly held their tongues and refrained from airing their opinions, but the very reverse seems to have been the case in the instance under notice. The ball was opened by one of the Commissioners throwing down the gauntlet in regard to the test of the main which he considered as unsatisfactory. After indulging in some badinage of the Chairman, whom he considered a legitimate object at which to level the shafts of his ridicule, he defended his position by alleging that "he had learned in connection with his own profession that it was not necessary one should be an expert to form an opinion on a subject. They could form an opinion on facts before them." If this is to be accepted in the sense that the opinion of an unfledged lawyer bears the same stamp of originality and carries equal weight with that of a mature lawyer, then we regret our inability to accord unqualified assent to such a dangerous principle. We are not learned in forensic lore, but as practical Engineers we may be permitted to say that a mere statement of facts, however exhaustive, in connection with our Profession is a poor substitute indeed for a knowledge of the theory and practice of Engineering which we consider as a *sine quâ non* in forming the basis of a sound and healthy opinion. Eliminating for the present this important factor in a consideration of this subject, let us see what conclusion could justifiably be arrived at with the facts before us. In order to do so we must recall the circumstances of the scheme from its commencement. When tenders were invited to lay the main, several contracting firms submitted estimates varying from seven to eight lakhs of rupees. On their being examined by the Municipal Engineer he very naturally, and in the interests of the Corporation, pronounced them excessive, and expressed his belief that the work could be effected as efficiently and at a much smaller figure if undertaken departmentally. This would save the Municipality a large sum of money which would otherwise have gone to the contractors. The question was referred to a Committee which, with the help of Mr. Kimber, prepared an estimate amounting to Rs. 4,38,000, that is, three lakhs less than the contractors estimated for. At the commencement of the work the Municipal Engineer proposed that as the scheme would entail a considerable increase of work to him, it was nothing but fair and reasonable that he should receive an extra allowance for extra work, which would be a very small sum in comparison with the saving effected. The Commissioners promised to give a favourable consideration to his claim to a bonus if the work were satisfactorily performed. But when the undertaking was finished there was an agreeable surprise for the Corporation, who found that it cost a lakh of rupees less than the original estimate and about four and a half lakhs less than the contractors had asked. If this does not entitle Mr. Kimber to his well-earned bonus we do not know what would. But it is unfortunate that the two questions of giving him a bonus and the application of a test should have been mixed up. Supposing he had expended double that sum and yet have shown a saving—would it not have met the entire approval of the Commissioners? The fact, however, is that those

who would indefinitely postpone the payment of the bonus, evade the main point at issue and cling to a technicality which ought not to have a place in the discussion. It is the question of the test to which the main should have been submitted, and the arguments on this head will be dealt with in another article.

SERVICE GRIEVANCES.

I.

FROM time to time the annals of rural Bengal, or the annals of this rural province or of that, are enlivened with a service grievance. A "service grievance" is to an administration what "dry friction" is to a piece of machinery. A provincial Governor who runs his province without getting up service grievances is like that coachman whose well-oiled vehicle moves silent and swiftly by. A Governor who elects to get up a service grievance reminds us of that country-made *bile ghari* whose slow travels involve an excruciating controversy between the wheels and the axle.

It is a remarkable fact that, if you consult one of the books of the "Inquire-within-upon-every-conceivable-subject" description, you find all sorts of topics ably discussed except just the sort that you require. Thus none of these useful manuals contain the recipe for preparing a service grievance. Take D, a departmental officer, who is able, industrious, and full of departmental experience. Have him the second in command in his own department and expectant of the natural promotion. Let the head of the department be removed—not violently but—by a peaceful decease or other "natural causes." Just as D is preparing to walk up-stairs let C, a junior in, or a stranger to the department, be catapulted over his head into the vacant chair.

It is particularly to be observed that only those privileged to use certain cabalistic letters after their names, are capable of catapultation. You must not shoot a young postal officer, however efficient, into the Police Department. You must not transform an energetic young policeman into an Inspector of Schools. You must not presume to reward an educational officer by making him Postmaster-General. This important principle may be otherwise formulated. Place yourself in imagination within the sacred precincts of a privileged Service. Then take note that all its energies are what may be called centrifugal. A youthful or hungry member of the Elect may be exported to the dinner table of an outer meritorious department. But the starving stranger must never be invited to a seat at the home feast. Why not? Simply because it is the business of the Service to look after their own stomachs. It is not their business to provide occupation for other men's gastric juice.

"Put not your trust in Secretariats" is our message to the men of a department. Why not? Simply because the atmosphere of a Secretariat is highly charged with the privileged element; and because there never was in this world, and there never will be, a *class* of men that could be trusted to do justice to other classes. Individuals may be generous—classes are always selfish. If any one class were invited to become pervadingly generous, while all other classes remained selfish, it might reply by a light adaptation of the answer of the witty Frenchman. This Frenchman was adjured to give his assistance to exterminate capital punishment. He expressed himself as honoured and delighted beyond measure to engage in so noble a work. "Mais je veux," he added, "que Messieurs les Assassins commencent."

The latest novelty in the grievance line is arranged in the Public Works Department. Some of the daily papers are suggesting to the new chieftain elect that he should decline such marvellous exaltation. We think this is going too far. It is not the business of any fortunate Official to preach justice or administrative tact. Still less is it his business to offer himself an official sacrifice on the altar of these great virtues.

To sum up. It is not for any particular class to abstain from grabbing all it can. It is for the power that stands outside the favored Services to measure to each its proper domain and to hint that "trespassers will be prosecuted."

BOMBAY P. W. D. CHANGES.

WE are informed in connection with our remarks on the "Stagnation of Promotion—P. W. D., Bombay," that Major-General W. W. Goodfellow, C.B., Secretary to Government, and Chief Engineer, First Class, retires immediately in consequence of promotion to Lieutenant-General, as also does Colonel J. LeMesurier, who gets the Major-General step vacated by General Fisher (Madras) retired. Probably the claims of seniority will be acknowledged, and General Goodfellow's successor will be found in Mr. J. H. E. Hart, Chief Engineer for Irrigation, who would probably be succeeded by Colonel W. M. Ducat—an appointment which will lead to much surprise, as Colonel Ducat has never been in the Irrigation Department in his life. Should, however, seniority be set aside, General Goodfellow's successor would be his brother, Colonel C. A. Goodfellow, V.C., the next on the List to Mr. Hart, and the vacant Superintending Engineership go to Colonel A. R. Seton, now at Home on furlough, with either Mr. J. E. Whiting or Mr. J. D. Little (Executives, First Grade,) to act.

Colonel LeMesurier, who is on the point of proceeding on furlough, will have to vacate his appointment in the Department at the end of this month (March). In the meantime Mr. W. S. Howard (Executive Engineer, First Grade) acts, and will be probably confirmed if his senior, Colonel Seton, is provided for in the manner mentioned above.

We may add that Colonel A. T. Mander, Superintending Engineer, is expected to retire in June next and Mr. F. D. Campbell, Executive Engineer, in September.

Lord George Hamilton, in replying to a question, in the House, denied that the Naval Designs sold by the Chief draughtsman at Chatham Dockyard, had been purchased by the United States, but he declined to state who had purchased them.

MR. Edgar Vincent returned to Cairo at the end of January last, from the petroleum fields, near Suez having during his visit thoroughly overhauled the workings at Jebelzett and Jetseh. The borings at the latter place, after obtaining a depth of over 400 feet, reached coraliferous strata impregnated with oil, which give every promise of a rich return. It is confidently expected that in the course of the next six months a large yield of oil will be obtained sufficient to take the place of coal in supplying steamships passing through the Red Sea.

Notes and Comments.

MR. H. DANGERFIELD.—We regret to hear that the Manager of the Kathiawar State Railway is seriously ill and will have to take leave to England at once. Mr. Dangerfield is in charge of considerable construction and extension works. His successor has not yet been nominated.

THE S.-P. S. R. SCANDAL.—Mr. Guildford Molesworth and Colonel Pemberton, R.E., are, we believe, about to pay a visit to the Sind Pishin State Railway, to investigate the cause of the enormous excesses to which we drew attention in a recent number. They will probably remain on the spot for about a month, as an exhaustive enquiry has been ordered. Some remarkable disclosures may be expected, that is to say, if they are ever allowed to see the light.

FRONTIER RAILWAYS EXTENSION SURVEY.—Mr. F. L. O'Callaghan has been appointed to have charge of the Kawja-Amrau Railway Survey as Engineer-in-Chief. The difficulties in the way of carrying a line across this range must be great indeed, when it is considered necessary to post a man of Mr. O'Callaghan's calibre and position in the Department to have charge of the Survey party. The Survey is placed under the control of the Director-General of State Railways.

IRRIGATION WORKS IN THE DECCAN.—The Bombay P. W. D Irrigation Branch are just now contending with curious difficulties and devices as regards torrent works—storage on the Ghauts of the splendid and unfailing rainfall. Some idea of the extent of these operations may be inferred from the fact that a reservoir is now under construction to hold 5,500,000,000 cubic feet of water—impounded by a dam which will be nearly a mile long when completed and over 100 feet high at centre.

THE EAST INDIAN RAILWAY AGENTSHIP.—Sir Bradford Leslie has been granted eighteen months' leave by the London Board of the East Indian Railway, and will leave by the end of March. Mr. D. Campbell will act as Agent during his absence. We trust that Sir Bradford Leslie will return to India with his health fully restored by his well-earned furlough, as in that case there is some hope that the vexed question of the Central Station for Calcutta may be settled once for all.

KASHMERE GUP.—We learn that the Railway Surveys are on the verge of completion under Mr. Favre, Assistant Engineer, and that Colonel DeBourbel, R.E., is, without prejudice to his other work, now engaged on the Kashmere water-works. Mr. Atkinson, the State Engineer, has just completed the Kahala-Garhi section of the Murree Road extension. This piece of road traverses difficult, mountainous, country ; it has been six years in progress, and has cost no less than ten lakhs of rupees.

MAJOR GRACEY'S APPOINTMENT.—There must be some mistake in the recent announcement so widely made regarding the appointment of Major Gracey, R.E., as "Chief Engineer" in Upper Burmah. Surely this must mean as *Engineer-in-Chief ?* Major Gracey's *pucca* appointment in the Public Works Department is that of an Executive Engineer, 1st grade, and his promotion over the heads of all the Superintending Engineers in his Branch of the Service would hardly be tolerated.

DEATH OF GENERAL HANCOCK.—General Hancock's death, which we chronicled last week, was painfully sudden and unexpected, and was in fact due to failure of the action of the heart. The sympathy expressed on this sad occasion was universal, and was testified to by the large gathering at the Military Cemetery at Alipore, near Calcutta. Owing to the day—9th instant—being a close holiday the news was not generally known till the following morning, otherwise the attendance would, we believe, have been far greater even than it was.

ANOTHER FAREWELL DINNER.—It has been decided to invite Colonel S. T. Trevor, the retiring Chief Engineer of Bengal, to a farewell dinner at the Town Hall, Calcutta, on Saturday, the 9th April, next. A large number of the members of the Bengal Provincial Branch have already signified their intention of being present, and amongst them are several native gentlemen. Colonel Trevor is justly popular with all branches of the Department and his departure will be regretted by everyone who has worked under him. He wlll probably leave for England on the following Monday.

THE GUNDUCK BRIDGE, T. S. R.—The latest news received from Hajipur states that the Gunduck Bridge will be opened on the 30th instant by the Viceroy, but this date is subject to alteration, and may be changed to either the 28th or 29th, so as to suit His Excellency's arrangements. The bridge will probably be tested about the 25th. The work has been carried out by Mr. R. A. Way, Executive Engineer, and consists of 8 spans of 250 feet with a half mile viaduct on one bank of the river. It connects the Tirhoot State Railway with the Bengal and North-Western Railway.

THE PUBLIC WORKS MINISTER.—We are glad to see that Sir Theodore Hope has been gazetted to an extension of service for 6 months. The notification caused great commotion and a considerable amount of "tearing around" in a certain Secretariat, but the news was received by the bulk of the Public Works Department with unmixed satisfaction. We hope that Sir Theodore's term of office may be again extended after December next, as we hold there can be no doubt that he has always endeavoured to promote the best interests of the Department as a whole. It is quite possible, however, that his action may have sometimes clashed with individual or privileged interests.

STREET LIGHTING IN INDIA.—There is certainly a great deal to be done in street lighting, as, with the exception of the three principal cities and the town of Jeypore, there are no gas works. In most Indian towns the streets are lighted in a very desultory manner by paraffin lamps, which are extinguished at midnight, and the rest of the town is always in darkness. The materials employed at Jeypore were originally vegetable oils, which have latterly been superseded by kerosine. The saving derived from the use of kerosine was very considerable, the vegetable oil gas having often cost £2 2*s.* per 1,000 cubic feet while that from mineral oil, as now produced, costs £1 1*s.* 10*d.*

WHITING'S STIFFENED SUSPENSION BRIDGE.—We are informed that the Drawings and Details of the Whiting form of Suspension Bridge—referred to by our correspondent "F. E. R." in last issue—were submitted to the Secretary of State for War as far back as 1867 and for which the author received the thanks of Government. The subject was brought forward in India, on the advice of General Wilson, late Military Member of Council, in 1885. This appears to have led to Captain Harrison's examination of the stressers developed in the structure published in the Roorkee Papers for October last. It is worthy of note that a Russian Officer made notes of the

rough experiments at Chatham in 1867 of a bridge of 112 feet span that General Simmons put up to test the Whiting method.

Bolan Railway Items.—Colonel Wallace has been up the Bolan Railway inspecting the line previous to opening it for passenger traffic up to Quetta. This was to have taken place on the 16th instant, and the Duke and Duchess of Connaught and suite will be the first passengers on the open line. A special carriage is being made for the metre-gauge line on bogies. Hitherto people travelling up this line were accommodated with a seat on a wagon load of rails or sleepers and received a shower of coal dust and dirty water, while they were half suffocated with smoke. The Fairlie Engines are very liberal in their supply of these, and their journey was never a pleasant one in consequence. The Westinghouse brake has not been found to work satisfactorily and is being replaced by the Vacuum brake.

Jobbery *in excelsis*.—Captain Buchanan Scott, R. E., has been gazetted permanently to the appointment of Deputy Consulting Engineer for Guaranteed Railways, in the place of Colonel Dowden, R.E. It is usual to make officers in this Branch of the Service serve on probation for a year or more before they are confirmed in their appointments. In Captain Scott's case this has not been considered necessary, and he has been appointed over the heads of two gentlemen, one of whom is much his senior and the other his equal in the Service. Both of these gentlemen, Mr. Howard Warden and Mr. E. W. Arundell, have served a year or more on probation in the Consulting Engineers' Department, and we fail to see why Mr. Warden should not have been confirmed, and Captain Scott appointed to officiate in the Branch. As these posts are looked upon as prize appointments on the Railway side, we cannot help characterising the present transaction as one smacking strongly of jobbery.

Hyderabad (Deccan) Water-Supply Project.—Various schemes have been proposed from time to time to solve the grave difficulty of a suitable water-supply for the Nizam's capital. It has been decided to make the Meer Alum Lake—described in our issue of the 5th February—the principal storage reservoir, as this reservoir is capable of supplying a reticulation of pipes that would embrace ⅘ths of the total area of the City with a head of 20 feet pressure, and will allow of the higher portion of the City, where the pressure is less than 10 feet, meeting its requirements from masonry cisterns. The cost of this scheme complete may be stated at 10 lakhs of rupees. The scheme for which Tenders are invited in our advertisement pages is a small project for the water-supply of the Hyderabad Residency limits to be carried out by the Local Funds Committee. The supply is to be taken from the Hussain Sagar Tank and conveyed by an open channel to Naraingooda and thence by iron pipes to the Residency and bazars. The scheme has been cheaply drawn up, as the expenditure is limited to about Rs. 50,000.

The Electric Lighting Act.—A very severe blow to the electric lighting industry in India has been dealt by the Government by the recent Enactment for regulating the supply of electricity for lighting and other purposes, which prohibits the use of electricity for lighting purposes without a licence from the Governor-General in Council. The draftsman of the Bill has evidently framed it on the British Electric Lighting Act of 1882, as it contains similar clauses, and has for its object the protection of the public against the supposed dangers attending the general use of the electric light. At first it was intended to insist on all wires being placed underground, and even at the present time it is doubtful whether a licence would be granted except under these conditions, as the authorities have taken an unreasonable opinion as to the danger of overhead electric light wires, possibly because the only systems which have been shown at work in India employ high tension currents, from which accidents are reported to have taken place in other countries, and this has been sufficient to frighten the engineer who advises the Council on these matters, although no disaster has occurred in India.

Bengal P. W. D. Secretariat.—The *Indian Daily News* of Tuesday last contains the following paragraph:—"We hear that Colonel McNeile, Joint Secretary to the Government of Bengal, in the P. W. D., who is shortly expected from England, is to officiate for Colonel Trevor. Colonel Harrison, the Officiating Secretary in the Irrigation Branch, will then continue to act in his present appointment." This information can hardly be correct, as, in the first place, it is not usual for two Irrigation Officers to act as Secretary and Joint Secretary to the Government of Bengal. Colonel McNeile has no experience in Railways, and will probably be appointed Secretary to Government and hold charge of the Irrigation Branch, while Colonel Harrison will revert to his substantive appointment as Superintending Engineer. The two best men available for the Chief Engineership of the Provincial and Railway Branch are Messrs. Horace Bell and F. L. O'Callaghan. Mr. O'Callaghan has, as will be seen in another place, been deputed to have charge of a Survey party, and may thus be considered to be provided for (!) and we understand that Colonel C. M. Browne, R.E., who is senior to Mr. Bell, is to be transferred from Burmah to Bengal to take up the duties of Chief Engineer and Joint Secretary in the latter province—otherwise, as Mr. Horace Bell is considerably senior to Colonel Harrison, R.E., his claims could hardly have been overlooked for an appointment necessitating experience in Railway works.

The Government of India, P. W. D. Secretaryship.—The question of General Hancock's successor is not yet settled, but several names are mentioned in connection with the Secretaryship to the Government of India in the Public Works Department. Probably Colonel S. T. Trevor, R.E., would get the appointment if he cared to take it, but we are informed that he has definitely settled to go home early in April, probably never to return to this country. Colonel Pemberton, R.E., Colonel Filgate, R.E., and Colonel Luard, R.E., are all supposed to be in the running, and we hope the choice will rest on either the first or the last named officer, as Colonel Filgate's want of touch with Engineering matters clearly disqualifies him for the post. In no other service in the world than the Public Works Department would it be possible that an Accountant, no matter how able, should be for an instant considered eligible for an appointment requiring the consideration of and the final settlement of the largest Engineering problems. In this connection the question forces itself upon one's mind—How long is it since Colonel Filgate entered the Accounts Branch, and what is the sum total of his Engineering experience? If, however, he should be fortunate enough to be appointed Secretary, it is probable that Major Begbie, R.E., will be made Accountant-General, and Mr. Macdonald Deputy Accountant-General. We understand, however, that Major Begbie goes home shortly, and in that case—Who is to be the future Accountant-General—Mr. Macdonald? or will Colonel Moberly's claims be considered on this occasion?

Current News.

Major W. Cumming succeeds Colonel Browne as Chief Engineer of Burmah.

The Behar Tramways Company has trouble on just now, and things are very much at sixes and sevens.

The necessary sanction has been obtained for the construction of the Nilgiri Railway, and the work will be commenced in a few weeks.

Lieutenant-General R. Fischer, Royal (late Madras) Engineers, has been permitted to retire from the service from the 11th of January.

We regret to have to announce the death at the early age of 46 of Mr. H. B. Fenwick, the Assistant Engineer to the Calcutta Municipality.

The great want of Madras at present is a Sanitary Engineer, to formulate and put into a practical shape the suggestions of the Sanitary Commissioner.

The construction of the Tounghoo-Mandalay Railway is being pushed on vigorously. The material train now runs about six miles beyond Tounghoo.

The terms on which the new Bengal-Nagpur Railway Company will take over the existing narrow-gauge line from Nagpur to Raipur have yet to be settled.

Although the Vizagapatam-Raipur line of Railway has been, on financial grounds, shelved for the present, there is every hope of the project being resuscitated.

We hear that the representatives of the Hyderabad Company have already commenced prospecting for diamonds in the vicinity of the once famous mines of Partial.

The Mysore Government has granted a square mile of land in the neighbourhood of Lackvalli, to the "Golden Hills Placer Company," for gold-washing purposes.

The quadruplex system of telegraphy recently introduced on the Bombay-Madras line has proved so successful, that it will probably be extended shortly to the Calcutta-Allahabad line.

The Secretary of State has sanctioned the extension of Sir Theodore Hope's tenure of office as Public Works Minister to December next—or for about five months, as his five years expire on 22nd July.

The vacant Secretaryship of the Public Works Department caused by General Hancock's death is not likely to be filled up for a month to come, pending, we suppose, the usual reference to the Secretary of State.

So many reductions have been made in the Executive Staff of the Public Works Department in Madras that it has been found necessary to reduce no less than five divisions to the rank of subdivisions under subordinate officers.

The Sonepore-Hajipore section of the Assam-Behar State Railway, including the bridge over the river Gunduk, will be opened with some ceremony on the 29th instant. It is understood that His Excellency the Viceroy will preside.

We learn that Mr. Syed Ali Bilgrami has been appointed Inspector of Mines on behalf of His Highness' Government, in connection with the Hyderabad (Deccan) Company, which, we hear, is largely extending its operations.

The decrease in the receipts of the Provincial Railways in the North-West Provinces and Oudh in the year 1885-86, as compared with the estimate, was Rs. 2,18,000, which was due to the falling off in the receipts of the Cawnpore-Achnera line.

A Madras paper states that an English firm, Messrs. Barton and Grindford, have applied to the Secretary of State for permission to undertake the construction of two lines of railway from a point near the Ramiswaram Canal to Madura and Tuticorin.

It is notified that the office of the Superintending Engineer, Tank Maintenance Scheme, will be closed from the 10th March 1887, after which date all communications on the subject of Tank Maintenance should be addressed to the Chief Engineer for Irrigation.

Captain Constable, Deputy Consulting Engineer for Railways, Bombay has gone to Jodhpore to open a new line on the metre gauge, being a continuation of the Maharaj of Jodhpore's railway to Pachbadra, were the Salt lake is situated in his Highness's territory.

A serious accident took place on the 11th instant morning at Kherwadi, a small station on the north-east section of the G. I. P. Railway line and about 150 miles from Bombay. Two goods trains collided, and the driver of the engine of the up-train was unfortunately killed.

We hear that the office of Inspector of Factories, Bombay has been abolished, and that Mr. Jones, the present incumbent, has tendered his resignation. His duties in the Presidency town will be performed by the Assistant Collector, and in the Mofussil by the several Collectors.

The Government of India have requested the various local Governments to furnish them with their opinions on the question of the appointment of agents in England for procuring English stores and appliances required by Indian Port Trusts under the direct orders of the Trustees.

During the absence of the Governor-General in Council from the Presidency, the Assistant Secretary in charge of the Military Department of the Government of India will have charge of that portion of the Government of India, Public Works Department, which is left at the Presidency.

For the Delhi-Kurnal Railway, a second Syndicate is understood to be in the field; this time hailing from Calcutta, with a proposal to make the line a broad gauge one, running from Delhi by Sonepat, Panipat, and Kurnal to Thanesur, from which last place it might ultimately be carried on to Umballa.

The report of the Directors of the Darjeeling-Himalayan Railway for the latter half of 1886 is an extremely satisfactory one. The gross revenue was Rs. 2,56,063, the highest on record, and the expenditure, including debenture interest, Rs. 1,50,414, leaving a net revenue of Rs. 1,05,649.

An invention has recently been patented by Mr. A. Rogers, C.E., of the Oudh and Rohilkund Railway, which bids fair to dispose of the long vexed question of the transport of fodder in times of war, and to altogether revolutionise, in fact, the Commissariat system, which is so apt to break down in any severe pressure.

A new line on the metre gauge from Mehsuna to Wadnagar, a distance of twenty-three miles, has been opened. It belongs to the Gaekwar for whom it was constructed by the Rajputana-Malwa Railway, who have also undertaken to work it for his Highness, finding engines and railway stock of every description at his expense.

We understand that it is intended shortly to bring the position and prospects of the officers of the Forest Department to the notice of the House of Commons; and that those members of the House, who devote their attention to Indian affairs, notably Sir Richard Temple, will strongly advocate the claims of the Forest Department to more liberal treatment.

We owe the late resolution of the India Office to resume the construction of the Bengal-Nagpur line, to Sir Theodore Hope's determination that the project should no longer be shelved. If it is further true that he wishes to convert the Rajpootana State line into a broad gauge one, and should succeed in accomplishing it, few men will have done so much for India as he.

The proposal made for amalgamating the Local Fund and Provincial Public Works establishments does not, we hear, commend itself to the Madras Government, who have informed the Government of India that the measure, if carried out, would not only be unproductive of economy, but that, also on political and administrative grounds, there are grave objections to it.

The Indian railways will shortly afford some important work to constructive and other engineers at Home. Tenders are invited on behalf of the Indian State railways, for plate girders of 4 feet spans; and likewise for girders and joists for superstructure of a screw pile wharf. The Indian Midland Railway Company is also requiring forty-two locomotives, together with a supply of iron bridgework.

A Madras paper hears that Mr. R. F. Chisholm has appealed to the Government of India, pointing out that his premature retirement from the Public Works Department, Madras, as Consulting Architect, was induced by his having been superseded by his junior; and expressing his willingness now to take up his post again, provided he is raised to the rank of Superintending Engineer, a rank he is entitled to by service. No decision has been as yet arrived at.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

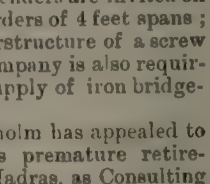
GARSON'S PATENT SUSPENSION BRIDGES.

Sir,—With reference to "F. E. R.'s" remarks in your last issue on the above, allow me to observe—

Firstly.—I do not think the introduction, as designed, of the top link will in any way alter the strains. Your Correspondent, "F. E. R.," seems to me to be of the same opinion in asking "is this link loose?"

Secondly.—The diagram is correct, the vertical strains will be only 3·25T.

Thirdly.—The $1\frac{1}{4}''$ pin is in double sheer, not in direct tension or compression. I should say it is not improbable that such pins would be steel. The bearing area of the pin is a to d, along the surface which in a $1\frac{1}{4}''$ pin with two $\frac{3}{8}$ cheeks, the area is 1·325 of superfices. Again, sheering strain in W. I. is allowed a higher factor than 4 or 5. The sectional area seems to me low, but with hard iron or steel pins would be ample.



X.

THE MEMBER OF COUNCIL FOR PUBLIC WORKS.

Sir,—I quote below a notice which has appeared in the *Pioneer* of the 5th instant:—

"If the existing precedent is to be followed, and also the analogy of almost every Continental State, in placing a Civilian at the head of the great spending departments, the selection of the next Public Works Minister will not be embarrassed by too many possible candidates. There is indeed one man who by common consent, both as regards the balance of his aptitudes, and his claims on the Government, would seem designed to reduce the number to almost a unit. We mean Sir Charles Elliott, who, as he appears to have cut himself adrift from his Chief Commis-

sionership in Assam, apparently meditates retirement from a field in which he has done such long and special service: with eminent capabilities in reserve. It may perhaps, however, be safely concluded that the Viceroy is too close an observer, and too careful of public interests and expectations, to permit one of the ablest of his officers to be lost to India."

No one who has watched the career of Sir C. Elliott can deny that he has rendered valuable services to the Government of India in his own sphere of life, but to pitchfork any individual, be he ever so able and acceptable to a certain class of officials in India, into a berth which should be exclusively filled by a Royal Engineer officer is jobbery of the meanest type. The extract from the *Pioneer* speaks for itself. I certainly do not understand the logic of the sentiments therein indulged in. Because a *precedence* has been established of placing a *Civilian* at the head of all spending departments out here and at home, and because some of the Continental States do the same, therefore it is a foregone conclusion that *a Civilian is the fittest person to rule the destinies of an important Service like the Indian Public Works Department.* I have said above that a Royal Engineer officer should be appointed to fill the place of the retiring Member of Council for Public Works. Half a century ago a Civil Engineer would have filled the post satisfactorily, but the times are changed now and we want more military men at the Heads of Services! R.

CALCUTTA SANITATION.

SIR,—Referring to your remarks in the last issue of the Journal on the Water-Supply of Calcutta, I would add that while in the Town itself there is an insufficient supply of pure wholesome water, the Suburbs get nothing at all: the inevitable conclusion is that a large portion of the poorer classes of the pepole, especially in the Northern Division and the Suburbs, depend for potable water on wells and tanks, which are in fact reservoirs of impurities, the contents of some of which, when analysed by the Municipal Analyst, have been found to be worse than ordinary London sewage. While this lamentable state of affairs is found prevalent in one part of the City, in another the supply greatly exceeds the demand. The Executive Committee of the Health Society very properly observes, "that the opulent residents in the south of Calcutta should have filtered water with which to water their gardens and wash their carriages, while the poor in the northern parts cannot get a scanty supply for household purposes, is an arrangement which, on grounds of justice and humanity alike, ought long ago to have been rectified." The effects of this inadequate supply are painfully brought into prominence with the outbreak of cholera during the last quarter of 1885, which was nearly three times the decennial mean, and far worse than any year since 1868. The Health Officer notes the following facts as to locality: "1*st*, a large grouping took place round tanks; and 2*nd*, most of the cases took place in those localities in which there was great scarcity of water." He shows on the clearest of evidence that in *bustees* with no drainage and no water-supply the outbreak was severe, owing to the water of the tanks being very foul. But let us not lay it as an unction to our souls that the reservoirs in the more favored localities in the Town are free from contamination. Dr. Simpson goes on to observe: "The same remark might be made of nearly every tank in Calcatta, and especially of those in the native quarter of the town. Human ordure is seen on the edge of the water and often adjacent to utensils for cooking purposes and storing water. The people in these instances simply bathe in, cook with and drink their own filth, and they might as well in many instances drink and bathe in the water issuing from a sewer. It is to water of this kind that some of the inhabitants are obliged to have recourse, owing to the great scarcity and very inefficient distribution of the filtered water-supply." What a terrible picture this is, and how true to life? Well may the Health Society be moved to represent the circumstances to the Government of India and ask for the establishment of "a consultative branch of the Public Works Department expressly in charge of sanitary engineering, and prepared to advise with knowledge and authority on all schemes of sanitary improvement and to supervise their execution."

CALCUTTA; *March* 15, 1887. HYGEIA.

Literary Notices.

A MANUAL OF INDIAN TIMBERS. *By J. S. Gamble, M.A., F.L.S.* Calcutta. 1886.

OPPORTUNITY has been afforded us to notice this very useful work which has been lately very freely and incorrectly made use of at Home by Commander Lovett Cameron, C. B., R. N. The author, or preparer, as he styles himself, Mr Gamble, was officiating Conservator of Forests in Bengal when the book was published, but afterwards was promoted to that grade and transferred to the Madras Presidency when the Forest Department there was organized. The "Manual" was printed and published by order of the Government of India. We have pleasure in directing the attention of those of our readers, who may not have seen it, to this book, as containing almost all the information that an Engineer requires to know regarding all the known timber trees in India.

In the introductory chapter of the Manual, Mr. Gamble explains that the book had its origin in the collection of forest products of India made for the Paris Exhibition of 1878. The series of wood specimens then contributed in the rough by the various Local Governments and their Forest Officers, and prepared and arranged in a central workshop, first in Simla and afterwards in Calcutta, by Mr. Brandis, the late Inspector-General of Forests, and Mr. Gamble, was so large and valuable that it was settled that besides the collection for the Paris Exhibition a number of duplicate sets should be also prepared, sufficient to supply a good stock to the Royal Gardens at Kew, and to other museums both in Europe and America, as well as type collections to be deposited in the offices of the Forest Conservators in the different provinces or circles in India, for reference by all persons interested in timber and ornamental woods and their applications to engineering works or industrial manufactures. Chief among these collections was that specially set apart for the Museum of the Forest school of Dehra Dun, and next to it in completeness in India was the collection deposited in the office of the Conservator of Forests in Bengal at Darjeeling, and these two collections, and especially the former, were chiefly used and consulted in the preparation of the Manual. But before the work was undertaken the materials available had been greatly augmented by various private collections.

Taking all these sources together, the number of specimens named, numbered, and described reaches 2,530, belonging to 906 species and 432 genera. All the wood specimens described in the Manual bear a letter and a number, referring to the particular specimen or series of specimens cut out of one log or piece, so that any numbered specimen in any of the reference collections can be at once compared with its description in the book, by the help of the copious index, and the list of specimens given at the end of the description of each species. The vernacular names of the timbers described are also given in most of the languages of India, and the index of these extends to 38 pages, so that it must be easy to identify any wood that an Engineer may come across.

Mr. Gamble has been careful to name in his introduction the books from which he regularly quotes, and he also appends a long list of books and published papers from which information has been drawn, and he requests it to be remembered that, excepting the actual descriptions of the woods, very little of what he gives is new, but has been compiled from all available sources of information. In this way the chief points of information recorded under each species are, he says:—

1. The scientific name—with synonyms (so far as the six books he generally quotes from are concerned.)
2. The vernacular names—selected with as much care as possible and with the spelling given according to the most ordinary system and the pronunciation of the word.
3. The description of the wood.
4. The geographical distribution as shortly as possible.
5. The record of all available information regarding rate of growth.
6. The results of all experiments regarding weight and strength that it was possible to quote.
7. The uses to which the wood and other products of the tree are generally put.
8. The list of specimens used in identification and description.

Though botanical descriptions of the plants which yield the timbers treated of have not been given, there is yet a vast amount of information regarding the genera to which they belong and the other species of these genera and regarding their geographical habitats, and the uses and qualities of the woods and other products they yield. The description of the timbers treated of in the Manual were all carefully drawn up by a Committee consisting of Mr. Brandis, Mr. Gamble, and Mr. A. Smythies, B.A., now Deputy Conservator of the Dehra Dun Forests. Dr. Warth, of the Dehra Forest School, also assisted in examining the specimens with a view to determine the rate of growth, and in weighing them.

General Articles.

ROLLERS FOR BENDING SHEETS OF CORRUGATED IRON.

THIS machine consists of 3 rollers, A, B and C, fitted to a wooden frame, *a b c d*; see figs. 1 and 2. The wooden frame is made up of two longitudinal pieces *a* and *c*, of two transverse pieces *b* and *d*, and of two vertical pieces *e* and *f*. The longitudinal and transverse pieces are joined together, by means of a joint shown in fig. 3, and stiffened by means of transverse bolts *t* and *t*—see fig. 1. The rollers, which are equal in size, are made of keekar wood, with corrugations cut on them. The bearings of the axles of A and B are of the form shown in fig. 5. The axle of C, the section of which is given in fig. 4, rests in circular holes made in the vertical pieces *e* and *f* of the frame. To prevent the axle from crushing the wood two washers 8" × 3" × ½" are placed both sides of the hole and bolted on to the wood. The roller C has got two handles only. When a sheet of corrugated iron is required to be curved, it is made to pass between the rollers C and A, B. The sheet being in contact with all the three rollers, A and B will also revolve with C and the sheet of corrugated iron will be curved as it passes through the rollers.

This appliance is now employed in the Punjab for the purpose mentioned. G. R.

THE MADRAS HARBOUR.

ITS CONSTRUCTION, DESTRUCTION, AND RECONSTRUCTION.

III.

IN March 1879, as we have seen, the Madras Government, in forwarding to the Government of India, with their approval, the report of the Madras Committee, which was in favor of an isolated breakwater, expressed a hope that the Secretary of State might be moved to send out a thoroughly qualified Marine and Harbour Engineer to examine and report on the feasibility of improving the Port by the construction of such a work, or by other practicable means. There is a *hiatus* in the correspondence, but this request was practically complied with by the instruction to Mr. George Robertson, F.R.S.E., M.I.C.E.,—who in 1870 was appointed by the Secretary of State for India to visit and report on other harbours on the Bombay and Madras Coasts,—to report also on the subject of the proposed Madras Harbour. The India Office did not think it fit to go to the expense of engaging a man at the very tip-top of the Profession to make such a prolonged visit to India as such an extensive investigation would involve, but they did the next best, or perhaps as good a thing, and on the recommendation of General Strachey, R.E., selected a man who had learned his work on the great Holyhead breakwater, who had afterwards been Resident Engineer on the London Docks Extension Works, and Resident Engineer on the Prince of Wales and Albert Docks at Leith, and, along with Mr. (now Sir) A. M. Rendel, was Consulting Engineer to the Leith Harbour Commissioners. The works at Leith, it may be remarked, involved the reclamation of a large area of land from the sea.*

After visiting Madras in 1871, and carefully considering the reports and designs of the Madras Committee and other authorities, Mr. Robertson came to the identical conclusions arrived at by the Committee, though not for the same reasons. In the first place, he fully concurred with them in condemning any attempt to form a breakwater, or piers of any kind, of a complicated structure, in a situation like Madras. This referred to the combinations of stone and timber, and stone and iron, already noticed, which had been proposed by various Engineers. In the second place, Mr. Robertson concurred with the Committee in recommending the construction of a breakwater, lying parallel to the shore in at least seven fathoms water, and at least 2,000 yards in length. He would have preferred to put it farther out, so as to give more deep water shelter, but that the increased section and necessarily greater length to shelter the same extent of beach, would make the cost more than the financial view of the question might warrant. He said that the breakwater should be perfectly straight, and have no splayed ends (such as had been proposed by Colonel Orr, and not positively disapproved of by the Committee) so as to give the greatest amount of shelter with a given length of breakwater. Mr. Robertson considered that the slope proposed by Colonel Orr and adopted by the Committee for the inner face of the breakwater, 1 to 1 from top to bottom, was too steep, and in his own estimate he adopted the slopes which the unpitched rubble deposit in the outer breakwater at Portland had finally assumed after years of exposure to the action of the sea—(see sketch opposite page 136 of INDIAN ENGINEERING for March 12th). He took the same height of crest above high water as the Commitee did, 6 feet, but objected to the proposed parapet wall above that height, saying that the sea should be allowed to come freely over the breakwater.

Mr. Robertson considered that the Commitee had over-estimated by 17 lakhs of rupees the quantity of stone that would require to be quarried and carried to site. They estimated for the quantity as if the breakwater would be solid, making no deduction for the space occupied by the interstices among the rubble, "recognising the necessity of providing a large surplus to make good wastage by the dispersion of some of the smaller material during the progress of the work, or before it should become duly consolidated, as well as by the subsidence of the stone in the bed of the sea." Mr. Robertson said that this was far too great an allowance. When he was at the Holyhead works, the quantity of stone to be quarried was calculated at 1 ton for 20 cubic feet, which assumed the interstices to occupy one-fourth of the bulk as deposited. One-fifth might therefore safely be taken off the quantity of stone calculated by the Committee, and enough margin still be left for the wastage alluded to by them. There was, in point of fact, very little waste in such a work, because the section was calculated at the full size the deposit was supposed to occupy after being shaped by the action of the sea. There was a little waste in quarrying, because very small stuff should not be carried to the work; but it was the railway freight that would make the construction of a breakwater at Madras so costly. And, in this connection, Mr. Robertson desiderated more inquiry into the best source of stone supply, as 51 miles was a long distance to bring a large daily supply of material, and the railway freight for that distance would amount to the cost of a very respectable length of special line to a quarry nearer at hand. But, as the freight paid to the guaranteed railway would go to reduce the amount paid by Government as guaranteed interest, this did not so much matter.

The real difficulty in constructing the breakwater, as proposed by the Committee, Mr. Robertson said, was the water carriage from the shore to the site of the work. The Committee proposed to construct a pier, 300 yards in length, for the purpose of facilitating the delivery of the stone into boats, thence to be towed by steam tugs to the site of the work, and there to be deposited by cranes. It was calculated that 2,000 tons might thus be deposited for 235 days in the year, and that the whole quantity of stone might therefore be deposited in eight years after the completion of the pier. Mr. Robertson's impression was that a very much longer time would be required, in a swell such as prevailed at Madras, in which the difficulty of shipping and depositing stones, some of them many tons in weight, could hardly be over-estimated. He said that the only way to construct the breakwater, *within a reasonable time and to be independent of the weather*, was to run a pier on screw piles, carrying two lines of rails, *out to the site of the works*, and that it would be the most economical way in the end. After

* Mr. Robertson's reputation, as a Marine Engineer, was so high that soon after his return from India he stood second, in a competition of some forty or fifty Engineers, for the important post of Chief Engineer to the Liverpool Dock Trust.

ROLLERS.

FOR BENDING SHEETS OF CORRUGATED IRON

Plan

fig. 1

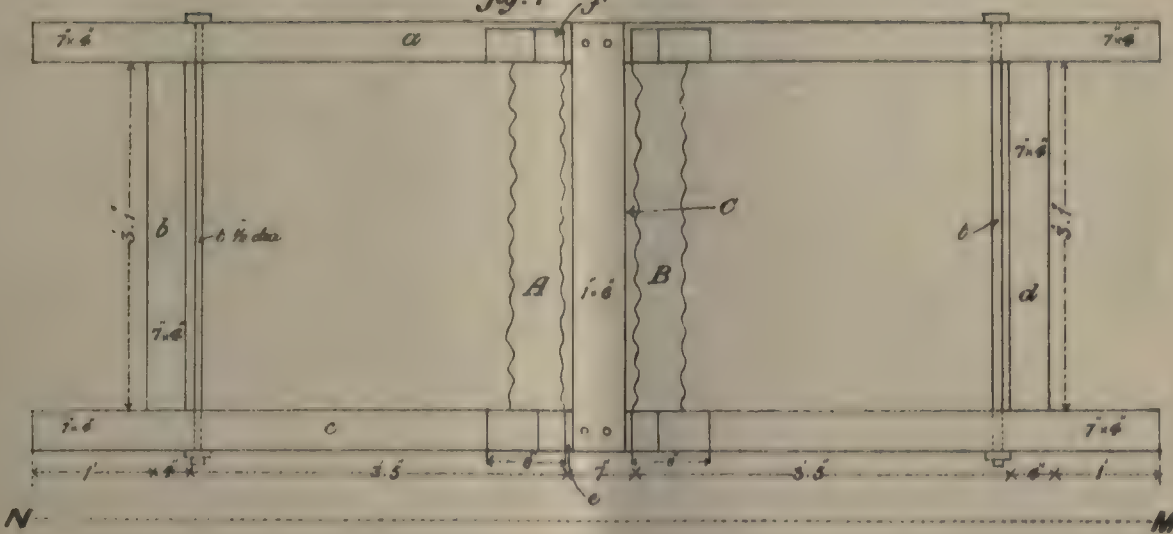
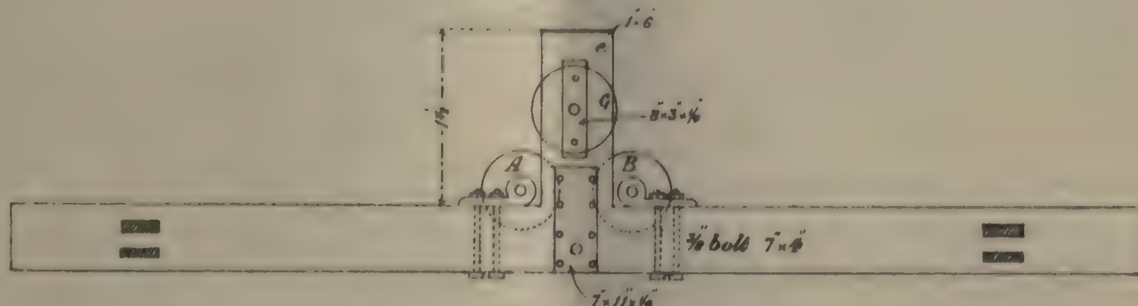


fig. 2

Elevation on N. M.



All the Rollers are equal in diameter.

fig. 3

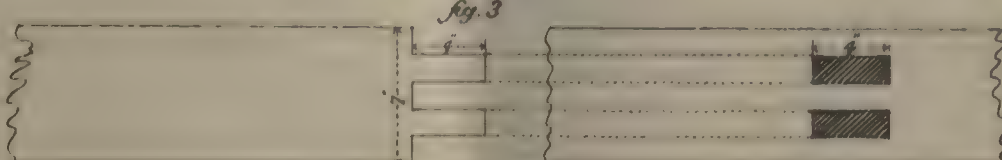


fig. 4

Section of Roller C.

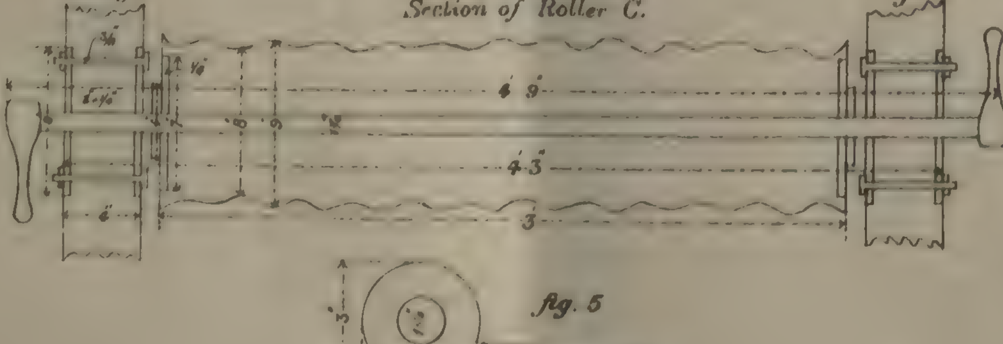
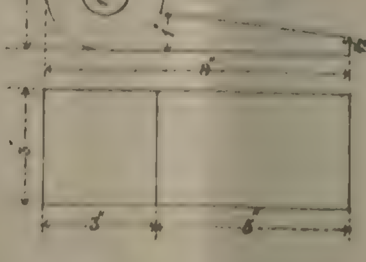


fig. 5



The "Star" Press, 19 Lall Bazar Street, Calcutta.

the site was reached the breakwater might be made either by an end tip, or from a staging, but he would advise the latter method, which had been used in almost all large sea works, ever since it was first adopted by the late Mr. Rendel at Holyhead and Portland. The cost of the staging would be amply repaid by the certainty and nicety with which the stone could be deposited and any part of the work fed with material as the sea pulled it out. He had at first tried all three ways of depositing stone, in the same work, at Leith, from boats, from an end tip, and from a staging, and the result was so much in favor of the last that afterwards he made that method imperative. By using a staging, he had known more than a million of tons of stone deposited in a year, and even 5,220 tons in one day. This however required very perfect arrangements at the quarries. The staging on the site of the breakwater should have on it five lines of rails. Mr. Robertson's estimate of the cost of a breakwater constructed in that manner, including a screw pile pier 1,200 yards long to connect the work with the land, was Rs 1,14,00,000, or, adding 15 per cent. for contingencies,—Rs. 1,31,10,000. The estimate of cost made by the Committee was, as has before been stated, Rs. 1,06,20,325, but they recommended Government to be prepared for this being exceeded by perhaps 25 per cent., which would give a possible total of Rs. 1,32,75,406, almost exactly the same as Mr. Robertson's total. He, however, considered that with good arrangements the breakwater might be very easily constructed in six years after the completion of the pier, instead of in 8 years as the Committee allowed, but which he thought much too little to allow if the work were carried out by their method.

(To be continued.)

THE CONSTRUCTION OF THE HONEY-CELL;

OR,

THE BEE AND HIS D. P. W.

BY A. EWBANK, M.A.

I.

THE Geometry and Construction of the Bee-cell require at one point of the discussion the assistance of the Differential Calculus. But there are many interesting features which can be described in the language of more elementary Mathematics, while others can be described in ordinary untechnical speech. And even the Differential Calculus can be removed from its one function if we choose to imagine ourselves obtaining by experiment and by a series of trials what the Calculus gives us by theory. Therefore this discussion will be intelligible throughout to readers whose mathematical studies were ended with simple Trigonometry, and much of it will be intelligible without any mathematical knowledge whatever. That purely geometrical problem for which the aid of the Calculus, if not indispensable, is still very appropriate, is not here published for the first time. Probably many mathematicians, working independently, have assured themselves that the shape of the Bee-cell has the curious property of being most economical of wax under certain pre-assigned conditions. But the greater part of the discussion to which I invite the attention of the readers of this *Journal* will contain ideas and reasonings which I believe to have been now for the first time published and now for the first time thought out.

When an insect—that has six legs—requires a home to sleep in or a nest for its young or a treasure house to store up food he may look about for some such accidental hole or crevice as in the trunk of a tree, or in rocky ground nature may already have provided. In such a case geometrical considerations are not particularly studied. The place must be large enough to hold whatever it is required to put there. The next desideratum is that the entrance shall be as small as possible. For in this case the existence of the hole is the less likely to attract attention from predatory wayfarers. Should the hole be observed then the smaller the entrance the more difficult it is for a large robber to get inside and the easier it is for the lawful tenant to defend himself and his property against an equally small but more heavily armed assailant. Given a spacious chamber approached by a narrow and not easily noticed passage the insect may readily put up with any other inconveniences which may attach to the place. It may be damp and its tender young may get colds on their chests—or it may be badly ventilated and the insect may creep out in the morning languid and half asphyxiated. But as there are humans (as the Americans say) who will readily endure all sorts of discomforts rather than give themselves the trouble of honest methodical labour, so there are insects that seem to have as little proper pride in the appearance of their houses or in the management of their children.

For an insect of this loafing description an unused keyhole provides a sumptuous mansion. The entrance is narrow and it cannot be enlarged by predatory teeth working at the outside. Once within the lock we find a suite of rooms as comfortable as heart could desire. We know that humans (Anglo-Indian or otherwise) coming to a new station are often prone to take as a matter of course the good things provided for them, with perhaps much difficulty, by their predecessors in the way of racquet courts, tennis courts, baths, &c. It is to be feared that some insects are equally thoughtless and ungrateful. But to a reflective female insect who comes on a keyhole which indicates by subtle dust indications that it is not used by other creatures it must seem that the carpenter who devised that structure was animated with much benevolent foresight for the needs of his future lady tenant. In one of its convolutions she can curl herself up for a sleep. In another she finds a chamber naturally adapted to an expected "interesting event." A third is a ready made larder where she deposits that tender remaining half of a young caterpillar which she captured in to-day's shikar. It is reserved to the morrow's early breakfast, for the damp morning air is good for no one upon an empty stomach.

When an insect of either sex can find no crevice handy or when he (or she) has methodical ways and is not averse from honest labour then an apartment is duly built and it is naturally built *round*. The chamber may be altogether as nearly round so as to be spherical or domelike with a flat floor—or it may approach the shape of a cylinder whose axis is horizontal; and here the roundness applies to the cross section. All that we have said about six-legged beings applies equally to four-legged beings and to bipeds either feathered or featherless. In all cases an animal naturally prefers to have as much roundness as possible. One cannot turn conveniently in a place where there are sharp corners. Thus we see that the untutored human—when he wants *one* chamber for himself or for himself and his squaw and his children—makes his habitation round and calls it a hut or a tent. If subsequently he takes to building *barracks* he may modify the round shape for obvious reasons. But we are dealing with primeval impulses and we can verify them in ourselves. Ask any man to dig you a hole in a field and give him no instructions about the shape or the object for which you require it. He will not make the hole of the coffin shape—that is roughly rectangular and longer than it is broad—nor will he make it roughly square. He will make it a rude circle.

But to bipeds, quadrupeds or six-legged creatures there comes a time when individual enterprise is replaced by something approaching the limited liability company. Now when men or insects wish for the sake of mutual protection or of co-operative advantages, to build huts or store houses in close proximity they find that the round shape involves two disadvantages. One is that space is wasted. Another is that material is wasted. There may be another disadvantage. This we will call the Engineering disadvantage. I mean that as each cell or chamber touches its neighbours only at points or lines, *i.e.*, small areas, they do not lend each other that mutual support which the awakening intelligence of the "Construction Department" may see to be desirable.

(To be continued.)

INDIAN ARROWROOT.

THE REV. JAMES DOYLE, Madras Irish Mission, favours us with the following Economic Note :—

I am sending you a sample of Arrowroot grown and manufactured at Place's Gardens, Kilacheri (Chingleput), by the Rev. Fr. Dominic. Judging from the results of the primitive methods adopted by him both in the cultivation and preparation of the tuber, I should say that as an Industry worked on scientific principles and with mechanical appliances, Arrowroot should prove largely and surely remunerative.

The eyes from which his last crop was raised, were put down at about a foot apart, in the month of July last year,—the ground having been first prepared as for a crop of *ragi* merely; the subsequent treatment of the plants did not differ materially from that of this hardy cereal. The tubers were dug up in November-December, and averaged 12 inches in length, with a diameter of 1·5 inches at their head. Only a small quantity was unearthend each time, as he believes that the tubers deteriorate by exposure to the air; and, accordingly, these were immediately divested of their sheaths, washed and reduced to a coarse pulp in a stone mortar with a wooden pestle. A portion of the pulp was now put into an earthen vessel and washed in a large quantity of water, and the washings were poured into a second vessel through a wire-gauze sieve, and allowed to settle. At the end of some ten minutes, the top-water was carefully poured off the second vessel, fresh water poured on the settlings, and after the whole had been well stirred, the result was strained into a third vessel through a piece of muslin, and left to settle a second time. At the end of a second ten minutes, the water was poured off from this vessel also, and the farina was discovered at the bottom as a white, firm, moist mass, and was taken out and spread on clean white sheets to dry. The residuum of each straining was returned to the first vessel, and treated a second, and occasionally a third time as the original pulp, before it was thrown away.

As only a very small quantity was grown and manufactured last year, I have made no attempt at calculating the yield *per* acre. But I found from a single day's observation that 18lbs. of the raw material gave very nearly 4lbs. of dried flour—this also represents the work (from digging to drying) of three men. Their wages at two annas a head was the only substantial charge on this quantity.

[The sample of Arrowroot received is pronounced by an Expert to be as good as anything of its kind now produced in the country.—ED., *I. E.*]

MUD ARCHITECTURE IN INDIA.

MUD has been used as a material for building purposes from the beginning of the world.

As civilization advanced, and people became wise, they used burnt bricks for their houses and buildings.

In all villages of India, almost all the houses are built of mud, and enclosure walls are also built of the same material.

Small Forts, called "*gurhees,*" are always square, and constructed of thick mud walls with a bastion (round, of course, in shape,) at each corner and a gate or entrance in one of the sides. All native fortified villages in the country have "*gurhees*" of this description.

Mud is used for building in three ways. First, mud is dug, and mixed with a little water, and made into clods, which are put in layers varying from 1 to 1½ feet in height. When one layer is dried another is laid on it and so on, till the required height is reached. Mud walls are generally made 2 to 4 feet thick and 8 to 15 feet in height. When the wall is thus built to the required height, it is scraped of all extra earth, and plastered with mud and straw mixed together, the mixture being watered and well trodden for three or four days before it is put on. This coat of mud plaster is from 1 to 1½ inches thick, and is called *kahgill.* It is used for mud roofs also, to preserve them, as well as the walls, from rain, &c.

The second mode of using mud for building purposes is *Pisê* work, which is neater, stronger, and more durable than ordinary mud walling. A detailed description of it is given below.

The third mode is to make the mud into bricks of the size of 12″ × 6″ × 3″ or any other size, and dry them in the sun. These bricks, when dry, are used for building walls of houses (inner walls generally, which are made thicker than the outer and exposed walls which are made of burnt bricks), and outhouses are generally entirely built of sun burnt bricks, plastered with mud and cow-dung mixed together.

Inner mud walls in houses are sometimes plastered with lime or gypsum, and ornamented with decorations, &c.

It will be seen from the above that the use of mud as a material for architectural purposes is similar to that adopted in Persia and other countries.

Thick mud walls and mud roofs add to the coolness of houses, and for Forts, thick mud walls answer better than brick or stone walls. The former resist artillery much better than the latter. Thick mud walls* of Forts cannot be breached (if they are breached at all) so easily, as stone or brick walls. Hence mud is used for fortifications to a considerable extent. Mud houses are, therefore, cheap and cool, and mud Forts strong and unbreachable.

2nd March 1887. K. L.

DESCRIPTION OF PISE WORK EXECUTED AT THE NEW JAIL AT UMRITSUR IN THE PANJAB.

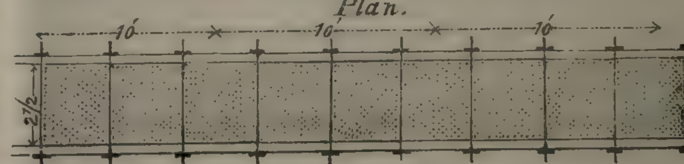
By Rai Bahadur Kunhya Lall, M. Inst. C. E., Lahore.

THE outer enclosure wall of the above Jail is made of pisê work, 2½ feet thick and 16 feet high with a *pucca* coping to preserve the top from rain.

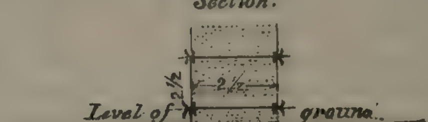
The pisê work is executed as follows :—

Two parallel rows of boards each 10′ × 2½′ × 2″ are first fixed at the distance apart of the thickness of the wall, which is 2½ feet, and kept in their position (straight and vertical) by means of thin bars of iron clamped outside, thus :—

Plan.



Section.



When the boards are properly fixed, then powdered clay with a very small admixture or sprinkling of water is thrown in between them and rammed hard in 6-inch layers. When the mass becomes firm and compact the boards are removed and placed further on in the same way as before, and earth rammed in between them as described above. When 2½ feet of the wall is thus finished, the boards are placed on top of it, in the same way as on the ground, the inner faces of the boards being plumb with the outer faces of the wall, and then another layer of 2½ feet of pisê work is added on the top of the first layer, and so on till the wall is made of the required height.

When the wall is thus built to the full height, all extra earth from its faces is scraped off and hollows filled up, and then a coat of mud plaster is given on both sides of it, which completes the work.

Pisê work walls require renewal of mud plaster every year, same as the ordinary mud walls.

28th February 1887. K. L.

MINING IN GREAT BRITAIN.

(*From our own Correspondent.*)

A FURTHER report has been published of the continuation of the experiments at the Archduke Albert Colliery near Karwin in Austria to ascertain whether variations of atmospheric pressure had any influence upon the volume of fire-damp in the air of the mine.

* These are generally made 15 to 30 feet wide.

The following conclusions have been deduced :—

The quantity of fire-damp in the air generally increases as the pressure of the atmosphere decreases, and decreases as the pressure of the atmosphere increases.

The quantity of fire-damp in the air increases most rapidly for sudden falls of atmospheric pressure, and decreases most rapidly for sudden rises of atmospheric pressure.

The quantity of fire-damp in the air is not proportional to the pressure of the atmosphere.

If after a sudden rise of atmospheric pressure, it continues to rise less rapidly or remains for sometime stationary at the maximum point, the volume of fire-damp in the air, which diminishes during the sudden rise of pressure, will gradually increase : and conversely, if after a sudden fall of atmospheric pressure, it continues to fall less rapidly or remains for sometime stationary at the minimum point, the volume of fire-damp in the air, which increases during the sudden fall of pressure, will gradually decrease. Consequently the maximum or minimum of atmospheric pressure will never coincide respectively with the minimum or maximum volumes of fire-damp in the air.

A serious accident occurred on 30th December at Houghton Main Colliery near Barnsley, resulting in the death of ten persons. The unfortunate victims were being drawn to bank, but owing to some accident to, or inadvertence on the part of the engineman, the cage was drawn rapidly into the head-gear, and continued to ascend even after the King's safety hook had detached the rope. The roof of the cage was crushed in, and the bolts which fastened the catch-plate to the girders were destroyed ; and as a natural result the cage, the safety hook, catch-plate and the unfortunate victims were precipitated to the bottom of the shaft nearly 270 fathoms deep. The Jury decided that the accident was due to the cage being "inadvertently overwound" by the engineman.

This class of accident appears to be preventible by the use of very simple apparatus. Levers should be arranged which would be put in motion by the cage when it ascends too high or by the banksmen in cases of accidents requiring the instantaneous stoppage of the engine. There would be suitable arrangements in the engine-house by which the steam would be cut off and the exhaust ports opened and a steam or other form of brake applied to the winding-drum. Arrangements would also be required for disconnecting the safety apparatus and working the engines independently.

It would appear that the hydraulic process is capable of application to the working of the ruby mines of Burmah. These mines are situated near Kyat-pyen, about 70 miles north-east from Mandalay. The gem gravel is found at depths varying from 20 to 30 feet, and of no specified thickness.

The application of the hydraulicing process would allow an examination of even the most sterile gravels at a cost not exceeding *2d.* or *3d.* per cubic yard. From experiments made in California it appears that a discharge of one cubic foot of water per minute is equal to the washing of from 1 to 3 cubic yards of gravel per 24 hours. The duty of the water being dependent upon the volume of water employed, the size and inclination of the sluices, the hardness of the gravel and the size of the stones of which the gravel is formed.

The recent crushing in of the Morro Velho mine of the St. John del Rey Company should prove a warning to all miners and especially to those managers who have adopted the system of premiums for reductions in the consumption of mine timber; which may be followed as in the case under consideration by the loss of human life and of the mine. There is a great difference between premiums for lessened consumption of coal and of timber.

The Bell and Ramsay wedge is now in daily use for mining coal in the Busty bank seam of Twisdale colliery, the output per day worked by this wedge being nearly 200 tons. It is intended that its use shall be extended to the whole of the colliery, and dispense entirely with the use of powder and other explosives for mining. This wedge consists of a wedge shaped bar and parallel feathers in sliding contact, the wedge being drawn out by means of a nut upon the screwed end of the wedge bar. It is operated by one man and will bring down the prepared block of coal in about 20 minutes. It appears probable that the Bell and Ramsay wedge will form a safe, efficient and economical substitute for the explosives now used in mines.

A map of the Ruhr coalfield has been prepared, shewing the collieries producing more than 2 cubic feet of gas per cubic foot of coal worked. It is found that they all lie in four belts or zones which exactly correspond to the four anti-clines in the coal measures. This evidence supports the theory that the magnitude of the issue of fire-damp is more especially dependant upon geological contortions and consequent compressions rather than to the constituents of the coal.

NOTES FROM HOME.

(From our own Correspondent.)

It was stated at the meeting of the shareholders of the Manchester Ship Canal Company, held lately at Manchester, that the new Directors felt confident in being able to obtain the necessay capital within the stipulated time and it was said that there was every reason to believe the undertaking would prove a financial success.

The *Railway Engineer* for February has an article on the "Hammer blow of Locomotives," in which the author deals with this subject as affecting various descriptions of locomotives. The second article is a description of a "32 feet family sleeping carriage on the Midland Railway," the details of the construction being explained by accompanying drawings. Then follows an extract from the *Indian Daily News* referring to certain proposals on behalf of the authorities which if correct must seriously affect the prospects of Civil Engineers connected with the Public Works Department of India. The other articles are : The Park Electric goods train brake and Railway Rates, Mr. Langley's patent Hydraulic-buffer stops, A 10-ton steam crane, and lastly, Eight official Reports on Railway Accidents.

To those of your readers who are interested in the development of the compound system of locomotives, an example is given in a recent issue of *The Engineer* of an express engine built by the North Eastern Railway for working the fast trains from Newcastle and the North. It has only been at work for a short time, and so far it is said to have fully realised anticipations, proving itself to be both economical and fast. Experiments I understand are now being carried out with this description of engine on the Great Western Railway where two engines, No. 7 and No. 8, have been tried. These are four-cylindered compound coupled engines with 7 feet driving wheels and were built last year, but are not in regular work yet.

The failure of crank axles is one of the most important questions that requires the attention of locomotive engineers and some particulars of breakages on the Northern Railway of France, which are quoted in Vol. 87 (just issued) of the Proceedings of the Institution of Civil Engineers, will be read with interest. The period embraced extends over the 5 years between 1881 and 1885, during which there were 58 cases of breakages; one in the bearings, five through the webs, and fifty-two through crank pins. These figures show the crank pin to be in general the weak spot. It is suggested that by drilling an axial hole $2\frac{3}{8}''$ in diameter through each crank pin it would be weakened to a very slight extent, while the insertion of a bolt therein would add enormously to its safety.

The first ordinary meeting of the year of the Society o Engineers was held last Monday evening when Mr. Perry Nursey resigned the Presidential chair to his successor, Professor Robinson, who delivered his inaugural address. In this the present education of the young Engineer was passed under review, together with the recommendations of Royal Commissions as to the endowments of certain schools. He hoped to see the establishment of a teaching University for London and conferring a degree of engineering. Reference was made to the projected Railway development in China and in Burmah. Mr. Robinson then described how water pressure was adopted for co-operative purposes, and as evidence of this mention was made of the success of the first works of this nature at Hull and which were followed in several other towns. Compressed air was also relied upon as an excellent means of transmitting power on the co-operative system, and the works now being carried out by Mr. Sturgeon and himself at Birmingham were mentioned. The successful employment of electricity for the purpose of locomotion were evinced by the Newry and Bessbrook Electric Railway and by the electric tram engine on the Manor Park line of the North Metropolitan Tramway Co. Reference was made to the establishment of country boards, the difficulty being in the administration of urban and rural affairs by one central authority. The Professor advocated very strongly

a modification of the existing legislation as would bring the letting or selling of houses under control as regarded health for, he pointed out, that it was an offence by Act of Parliament to sell food unfit for consumption and which was a danger to health and in like manner it should be an offence to sell or let a house when in an unsanitary condition, it being equally dangerous to health.

I have recently had an opportunity of inspecting a length of sewer ventilated on Mr. Harrington's system. Near the centre of the length of the sewer a 15-inch pipe is inserted at springing level, and is connected to a shaft by pipes of a similar diameter. The shaft is fixed against the side of the house opposite, and terminates in a lobster backed cowl, which is so arranged as to present its face to the wind. The cowl is 32 feet above the level of the street and is above the roof of the house. At the high end of the sewer a 12-inch pipe connects the sewer with a shaft that is fixed against the house opposite and which terminates with an open mouth above the room at the height of 22 feet above level of the street. At the lower end of the sewer a similar arrangement exists, the height of the shaft being 31 feet above the level of the street. The operation of the system is automatic. When the wind blows the mouth of the cowl turns to it. The air intercepted by the mouth of the cowl is forced down the shaft by the pressure of the wind and so into the sewer where it separates into two currents, one of which goes up the sewer to the pipe and shaft at the high end, where it escapes into the air above the houses, and the other passes down the sewer to the pipes and shafts where it escapes in a similar manner. Experiments were made to test the passage of the air that over 44 days' air entered the sewer at the rate of 140 cubic feet per minute sufficient to change the air in the sewer 46 times per day. The influence of this vast volume of air daily passing through the sewer could be clearly seen. The sides of the sewer are dry instead of having on them an offensive coating as in an unventilated sewer.

COLOMBO HARBOUR WORKS, CEYLON.

By John Kyle, M. Inst. C. E.

We subjoin an account of Sir John Coode's great work at Colombo, from the Proceedings of the Institution of Civil Engineers, for purposes of comparison with Mr. William Parkes's greater undertaking at Madras, now under description in this *Journal*:—

The idea of providing Ceylon with an artificial harbour was originated by the Earl of Carnarvon, who, in 1866, suggested the improvement of the natural harbour at Pointe de Galle with this object. In 1870, however, the Governor, Sir Hercules Robinson, pointed out that Colombo was the best place for providing increased harbour accommodation. It was shown that Colombo, being only 30 miles out of the direct course between Aden and Galle, and 18 miles from the direct course between Bombay and Galle, might serve as the great coaling station of the East; and that Colombo was a more accessible port than Galle, being free from the treacherous currents which exist off Galle. Moreover, the tonnage of Colombo had increased more than thirteen-fold between 1830 and 1869; and the trade statistics proved that a revenue of £32,000 might be raised for the harbour works. Accordingly a report was obtained from Mr. R. Townsend, M. Inst C. E., who advised the construction of a harbour on the site of Colombo Lake protected by a breakwater seawards, and a rubble jetty on the land side, with an entrance between them in the rear of Custom House Point, at an estimated cost of £720,000.

In 1872 Sir John Coode, Vice President Inst. C. E., having had Mr Townsend's scheme submitted to him, advised the construction of a breakwater from Custom House Point, as best suited to meet the requirements of the Colony; and this recommendation, having been approved by the Home and Colonial Governments, Sir John Coode was instructed, early in 1873, to take the necessary steps for carrying out the work.

The scheme, as executed, comprises the sheltering of a water-area of 502 acres, at low water, by a breakwater, 4,202 feet long; the reclamation of some of the foreshore as a site for coal stores; and dredging some of the shallow portion of the harbour to a depth of 26 feet at low water Fig. 1. As it was resolved to construct the works without a contractor, the Author was appointed Resident Executive Engineer in May 1873. During a visit of three months to the Colony, he investigated all the conditions of the site; and having arranged for the opening out of a suitable granite quarry, the formation of a block yard at Galle Buck, and the construction of lines of railway from the quarry to the main line, and from the Colombo terminus to the works, he returned to England, when the plans and arrangements for carrying out the works were settled with Sir John Coode; and in June 1874 the engineering staff arrived at Colombo. The foundation stone of the work was laid on the 8th of December 1875 by H. R. H. the Prince of Wales, Hon. M. Inst C. E., during a visit to the Colony; and the works were completed in April 1885 at a total cost of Rs. 84,62,484 or £705,207.

PRELIMINARY WORKS.

Quarry.—The quarry is situated at Mahara, $1\frac{1}{2}$ mile from the main line and 11 miles from the Colombo terminus. About 8 acres of land were obtained, rising about 98 feet above the service railway, and containing about 500,000 cubic yards of granite having a specific gravity of 2·625. The first train-load of rubble was delivered at Colombo in October 1874; the minimum output was 100 tons a day, and never exceeded 600 tons owing to the limited extent of the working floor-space. The top rock was bored from 12 to 18 feet deep by $2\frac{1}{2}$-inch drills, and blasted down in masses by pebble-grain powder; and then redrilled with $1\frac{1}{4}$ inch holes, from 6 to 8 inches deep, and broken up by $\frac{3}{4}$ to $1\frac{1}{2}$-oz. charges of Nobel's dynamite. The firing was done out of working hours; and the blasting-operations were all effected by free labour, whilst convicts were employed for loading the wagons. Accommodation was provided at Mahara for three hundred convicts, who worked in the quarries, and proved an important addition to the breakwater staff and a great profit to the Colony.

Branch-lines.—The breakwater branch commences at the Colombo terminal station, and, skirting the lake along Norris Road, terminates at Galle Buck. It has a total length of 1 mile 62 chains, and cost £17-210 exclusive of land. The Mahara quarry line, having a length of 1 mile 34 chains, branches off from the main line at the ninth mile from Colombo, and cost £5,979.

Block-yards.—The site at Galle Buck had to be levelled by the removal of 26,368 tons of granite and 66,726 cubic yards of earth; and 6,860 tons of the granite were utilized in the construction of a north and south dry stone sea-wall, reclaiming some bights along the shore. Workshops were erected, and lines laid down on this site Fig. 1. A cement-shed 205 feet by 35 feet was erected near the stone-breaking and dry skip-filling yards, with a cement floor raised on *débris* 2 feet above the ground; being close to the sea, it was walled in on three sides and roofed without ventilation, so as to exclude the sea-air from the cement. Two cement floors, each 1,000 feet by 53 feet formed of a $2\frac{1}{2}$-inch layer of cement mortar placed on 18 inches of well-packed rubble, were laid down for block-yards, with three lines of way between them and a service road running along the centre of each floor Fig. 1. Two 32-ton overhead travelling-cranes, tested to 42 tons and two 3-ton travellers, stretched across the floors, could traverse their length on outside rails to a 53-foot gauge; the former being employed in loading the blocks when made, and the latter in discharging the dry and wet skips into the machines and moulds.

ROOT WORK.

Sea-wall.—The Root work, extending seaward of Custom House Point, and covering an area of 5 acres, formed a starting point for the breakwater, and enclosed a reef of dangerous rocks. On the seaside, it is protected from the south-west monsoon by a wall of three courses of 7-ton concrete blocks, with occasional buttresses of blocks at the back, resting upon a rubble mound at about half-tide level and backed with rubble Fig. 4. The tipping of rubble was commenced in January 1875; 28,259 tons of rubble were deposited in the work, at a cost of £7,109; and four hundred and ninety-eight blocks were laid, at a total cost of £3,321. The blocks were laid by the aid of two sheer-poles and 3-ton hand-winches; and the quarrying of the stone, and the manufacture and setting of the blocks, were performed by convict labour.

Depôt-wharf wall.—This wall, under shelter of the breakwater, consists of concrete cylinders with a concrete-in-mass superstructure and backed with rubble. A portion of the wall, on each side of the eastern corner, is built on a double row of 5-foot cylinders, founded 16 feet below low-water ordinary spring-tides; and the remainder of the north-east wall nearly up to the breakwater, is on 7-foot cylinders, founded 28 feet below low-water, with concrete-in-mass capping joggled 6 and 9 inches respectively into the cores of the cylinders Figs. 2 and 3. The junction piece, up to the breakwater, is built of concrete-in-mass on a boulder reef. The total length of the wall is 829 feet; and the coping is 9 feet above low-water. The 5-foot cylinders were in sections, $3\frac{1}{2}$ feet deep and 3 feet internal diameter, and the 7-foot, 4 feet 10 inches deep with a $4\frac{1}{2}$-foot core, weighing 3 and 7 tons respectively. The ordinary rings were composed of 3 parts of stone, 2 of sand, and 1 part of cement; but the cutting rings were made with one-fourth part of cement. The total cost was £22,317.

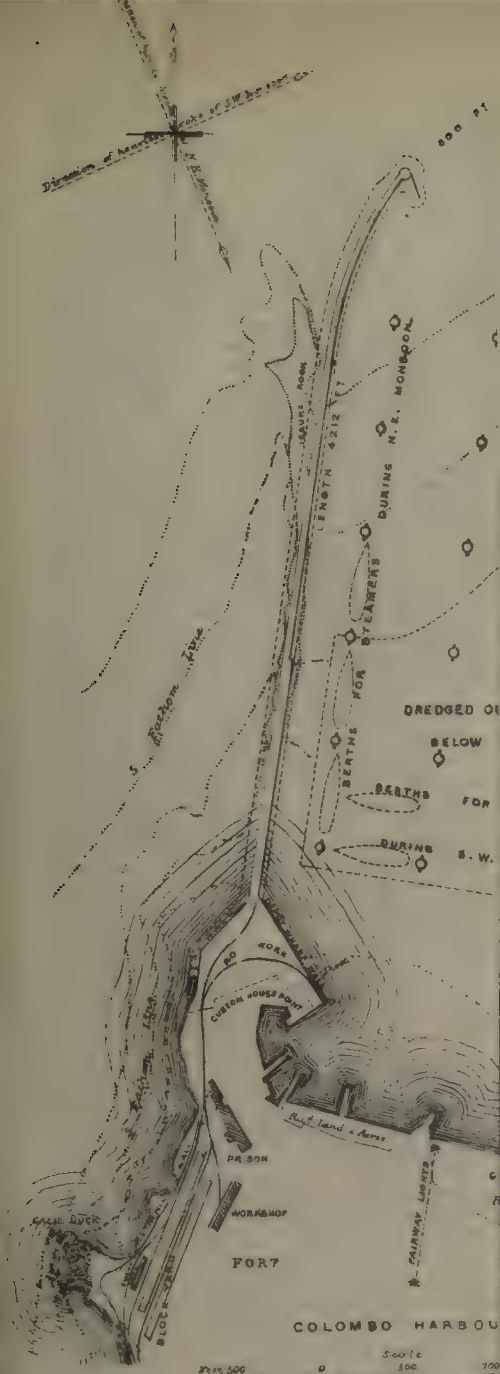
Rubble and earth filling.—The surface level of the Root is 10 feet above low-water. The filling consisted of 131,424 cubic yards of earth and 26,368 tons of rubble, obtained from Galle Buck, from a "cabook" cutting on the Kandy Railway, and from harbour-dredgings, and cost £17,329. The surrounding conditions, and the expedients necessary to preserve the filling from the backwash of each south-west monsoon, rendered the Root work costly.

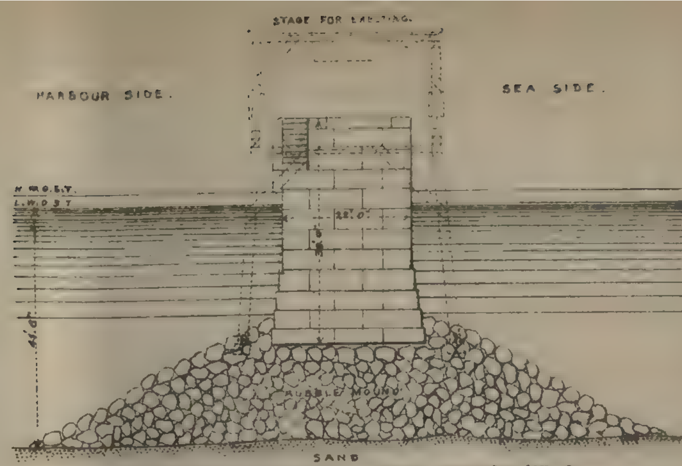
Abutment block.—A huge block of concrete-in-mass, weighing 320 tons deposited within timber casing lined with canvas, in 16 to 24 feet of water, on the jagged rock, forms an abutment for joining the breakwater to the Root. After the destruction of one casing by a westerly storm, the work was completed in April 1876 at a cost of £ 976.

BREAKWATER.

Delivery of rubble.—The stone was loaded at the quarry into side-tipping wagons, and on the arrival of the train of about twenty-four wagons at Galle Buck, it was distributed between the yard and the shoot at the depôt wharf. A train of ten wagons was run alongside the shoot, and the rubble tipped into the well of the hopper-barge. The iron shoot, 13 feet by 11 feet, was supported at the sides by a timber frame pivoting between uprights through which the lowering and raising chains were reeved. The amount of rubble thus delivered into the hopper-barge was 141,147 tons.

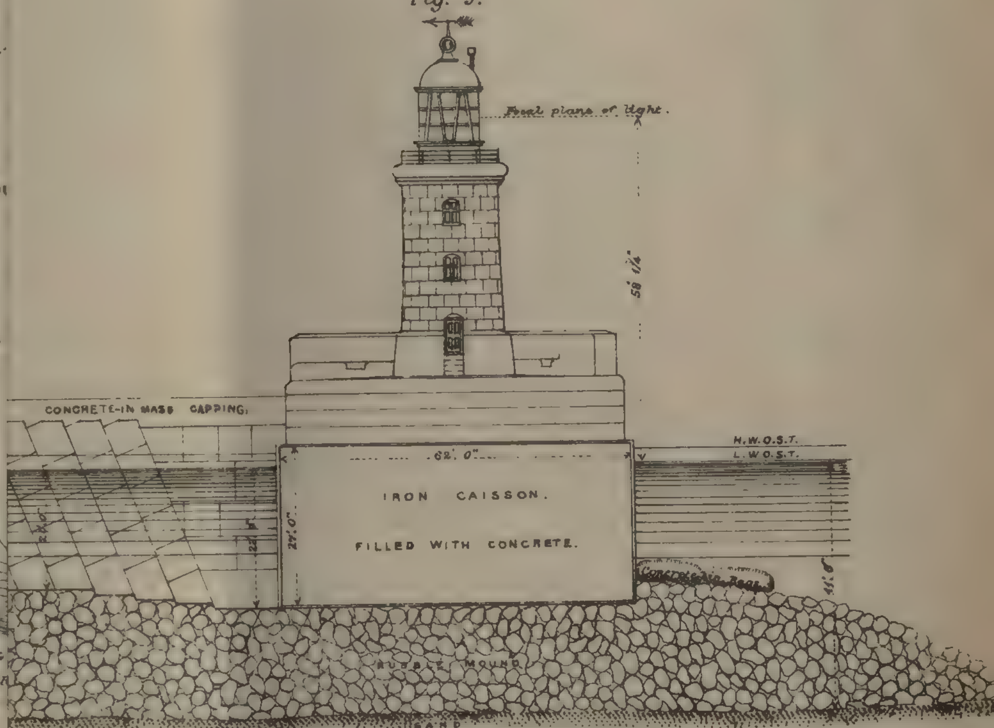
Depositing from hopper-barge.—The 80-ton steam hopper-barge, running 6 knots an hour with a full load, was loaded from the shoot alongside the depôt wharf; and on reaching her destination ahead of the breakwater, the exact position for dropping the cargo was ascertained by means of high diamond and circular-shaped beacons on shore, and floating beacons in the sea. Five tiers of cargoes were deposited on the transverse line by means of marks on the vessel's gunwale, corresponding in shape to the land beacons numbered from 1 to 5. Three transverse sets of buoys were placed at the end of the





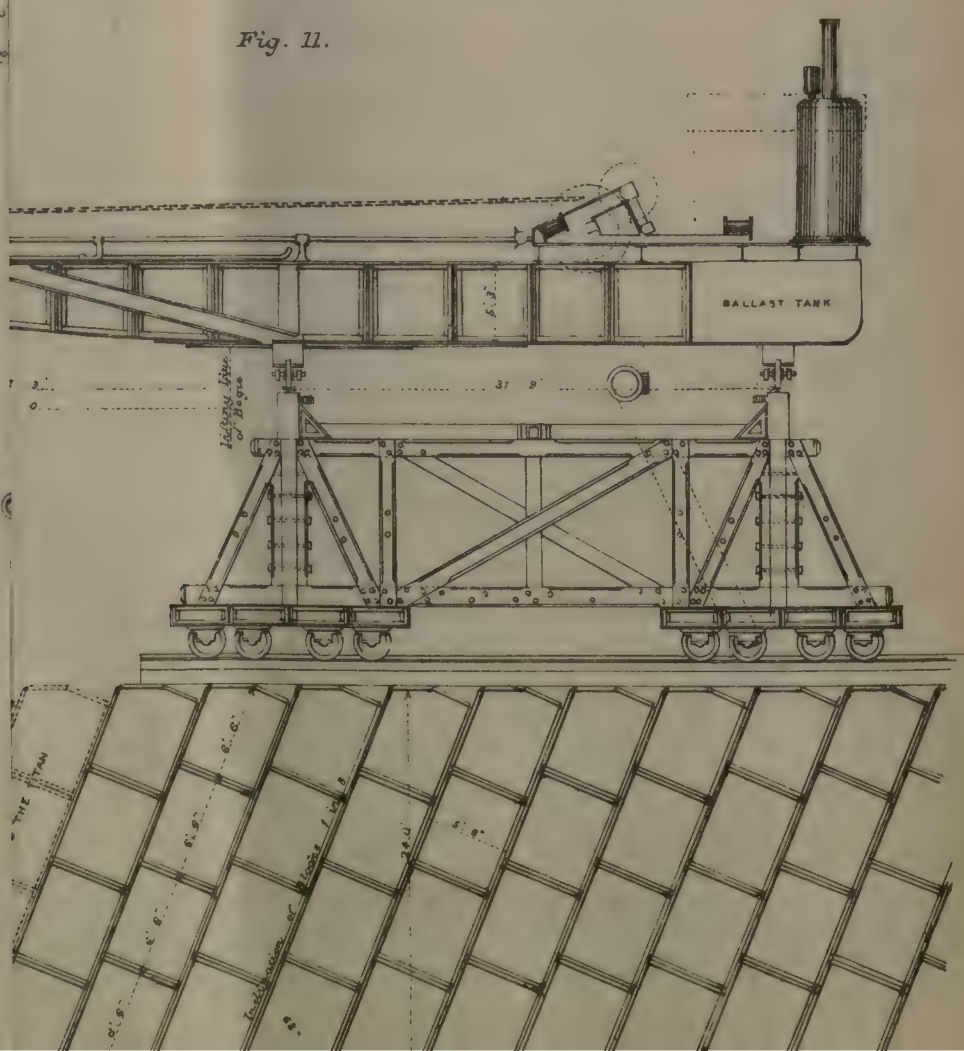
SECTION OF LANDING JETTY AT PIER HEAD.

Fig. 9.



PIER HEAD AND LIGHTHOUSE.

Fig. 11.



COLOMBO HARB

work, making the lines of the tiers of cargoes; and the man stationed at the number of the cargo to be dropped shouted out "let go" on getting into the corresponding beacon line. Cross sections of the mound are given in Figs. 5 to 7.

The top of the mound was usually kept about 2 feet below the foundation-level of the pier-wall, and was subsequently raised by the hand-cargo boats and divers. The length of mound completed each season varied from 500 to 900 lineal feet, being kept in advance of the pier at least a length equal to the progress of the wall during the same season; so that having a whole season to consolidate before receiving the superstructure, the chances of undue settlement were reduced to a minimum.

Berms and Hearting.—During the block-setting season, thirty-five wagon-loads of stone were daily discharged from the wall into the hand barges alongside, from whence they were thrown over on to the mound as directed by the divers. Eighty-five wagon-loads a day were at the same time deposited on the sea and harbour berms of the breakwater, to make them up to their full section; and a portable shoot of old rails was provided for this purpose, overhanging the face of the wall, having the same slope as the bottom of the tip-wagons at their angle of discharge, and capable of withstanding the shock of falling pieces of rock of 3 tons weight Fig 7. Large blocks could thus be deposited, over a core of ordinary rubble, for protecting the berms in bad weather; and the berms were always fully made up at the close of each season. At the commencement of the setting-season, a series of cross sections of the mound were taken, 50 feet apart, whereby any settlement was detected, and was then made up with 3½-ton rubble. In shallow water, the berm was exposed to the action of the sea for about three years before reaching the condition shown Fig. 5.

The quantites of rubble deposited in the mound, berms, and hearting, were 141,147 tons by the hopper-barge, 104,479 tons from boats, 59,822 tons on berms, and 14,917 tons by hand in hearting.

Bag-work on Sea Berm.—An apron, 24 feet broad, composed of 10-ton bags of concrete, protects the top of the sea berm from disturbance Figs. 5 to 9. The bag, having been sewn up on five sides, was adjusted in a skip, carried on a wagon under a shoot, through which concrete was poured into the open mouth of the bag from the mixer-skip. The top of the bag was sewn up during its journey to the derrick, by which the skip with its contents was hoisted, run out, and lowered, and the bag dropped into its place Fig. 6. No damage was done to any bag, either by the sea, or by the rubble mound on which it fell. The depositing of the bags was commenced on February 11th 1884, when the progress sections showed that the first length of 2,150 feet of berm, having attained its normal slope, was ready to receive the bags; proceeding landwards, the whole seven hundred and twelve bags were deposited, up to the junction line by the 2nd of April following. About sixteen and three-quarter bags, in a single row, covered a length of 100 feet; and the average space between each bag did not exceed 3 inches.

The total cost of the rubble mound, berms, hearting, and bag-work, up to the end of 1884, was £106,553.

Block-making for Pier-wall.—By the end of 1876, six hundred blocks, averaging 20 tons each, had been made and stacked in the yards. Owing to the unavoidable deficiency of storage space, the blocks were stacked close together, two deep, in the yards, and also two deep on the harbour-wall of the breakwater, by which means two thousand blocks were in stock on the arrival of the setting season; and all blocks over six weeks old were set in the work.

During the monsoon season, the prisoners worked eight hours a day; in the setting season, a twelve-hour system was adopted. In the slack season, one hundred and sixty-six prisoners manufactured six blocks a day; whilst during the twelve-hour system, three hundred and nine prisoners made twelve blocks a day, without increasing the cost per cubic yard. A charge of 37½ cents per day of eight hours was made for each prisoner employed, which included the guards and police in charge of the gangs.

The trains of dry materials consisted of eight wagons, with two skips in each; and the skips were divided into three compartments, containing stone, sand, and cement, in the proportion of 6, 2, and 1 respectively. Travelling 3-ton gantries, with an overhead travelling steam-winch, were used for lifting the dry, and depositing the wet, materials. When the mixture was poured into the mould, two masons and four prisoners forced it into the corners and sides of the mould with iron-shod rammers; after three days the mould was removed, and three weeks later the block was stacked.

Block-setting in Pier-wall.—Twelve divers, with nineteen attendants, prepared the bed on the mound in advance of the wall; they worked three and a half hour shifts, in relays of four divers each, at a total daily cost of £9 7*s.* 6*d.* The divers used four 6-foot lengths of 50lb. rails for levelling the bed, which were ringed at each end for moving them about; and they finished off the surface with a trimming of small quarry chips.

The concrete blocks were set by a Titan Figs. 10 and 11, the first block being set on the 12th of December 1876. The Titan could carry a load of 40 tons, on an overhang of 28 feet; its weight, including rubble ballast, water, fuel, &c., was 180 tons; and it cost £5,562 set up in Colombo. The foundation blocks, standing on the slant on the truck, with the lewises vertical, were lifted by the Titan in that position; but the other blocks, being square, were lifted in the yard on to the truck by a pair of outside grips, and when canted on the truck to the setting angle of 68°, the lewises were dropped in vertically, and the block was raised and set by the Titan. The five courses, of three blocks each, in the 34-foot wall were set in seven hours Fig. 7; and under the most favourable conditions, thirty blocks were set in twelve hours. The Titan, in passing over the work as it progressed, made it settle from 3 to 5 inches; and a further settlement of 5 or 6 inches was effected by the waves of the south-west monsoon, giving a total maximum of about 9 inches, for which allowance was made by keeping up the scar end as the work advanced.

Along the inner portion of the breakwater, consisting of two walls Fig. 5, a 40-ton steam derrick was used for setting the harbour-wall blocks; it travelled on the sea-wall, and its jib hung over the harbour-wall.

The lines for the Titan, derrick, and trains were fixed upon longitudinal balks, secured to the wall by dowels and concrete-in-mass, so as to resist the attacks of the south-west monsoon waves, and enable the Titan to be drawn to land after the close of the setting-season; for the experience of the first stormy season showed that it was not safe to leave the Titan out on the breakwater.

Joggle Grooves, Scar End, and Capping.—The joggle grooves left between each row of sloping blocks Fig. 10 were filled up to high-water level with strong concrete in bags, dropped into the hole and rammed down hard.

Towards the termination of each season, before the setting in of the south-west monsoon, the three last upper courses of the scar end were secured together, through their lewis holes, by four 2-inch wrought-iron screw-bars, stretched longitudinally over the work, to prevent the sea disturbing the blocks.

The final capping of the pier-wall with concrete-in-mass binds all the top blocks together, and gives additional weight to the structure. It is 48½ feet broad across the wide inner portion of the pier, and 31¾ feet across the outer portion; and 4 feet deep in the centre, and 3½ feet at the sides. The concrete was mixed by the machine in the yard, and sent off in a series of three trains of one wagon, each carrying four skips.

Pier-wall.—Near the land, the wall was founded 13 feet below low-water; this was increased to 16 feet at 977 feet, to 20 feet at 2,070 feet and continued at this depth close up to the pier-head, where the foundation was stepped down to 23¾ feet below low-water Figs. 5, 6, 7, and 9. The block-work rose to 8 feet above low-water and the capping raises the centre of the wall to 12 feet above low-water.

The first 1,326 feet of the pier was built with a sea and a harbour-wall, having an interval between them of 14 feet, filled in with rubble Fig. 5. The sea-wall consists of two foundation blocks, 13 feet long and weighing 28 tons each, supporting three courses, 24 feet long, composed of blocks of 14 to 26½ tons each. The harbour-wall is 12 feet wide, making a total width of 50 feet. At 1,326 feet from the commencement, a single wall, 34 feet in width, was adopted, with four to five courses of blocks weighing from 16½ to 31 tons each Figs. 6, 7, and 10. The sloping joints are 5½ feet apart on the square, and have an inclination of 68° to the horizon Fig. 11. The last sloping courses of blocks, and the closing blocks up to the pier-head, were laid before the close of the setting-season, in March 1883 Fig. 9.

The total number of blocks placed in the pier were nine thousand six hundred and fifty-six, containing 124,984 cubic yards; and their total cost in position was £247,313.

Pier-head.—The pier-head consists of a circular block of concrete-in-mass, 62 feet in diameter and 27 feet high, surmounted by another block 60 feet in diameter and 11 feet high Fig. 9. The lower portion, being under water, was deposited in a wrought-iron circular tank, formed of ½-inch plates stiffened and braced by T-irons and angle-irons, with a square corner to fit on to the pier-end. The tank was ballasted with 400 tons of concrete-in-mass, and subsequently towed into position with a further load of 600 tons, which left it a freeboard of 5 feet.

A favourable opportunity occurring on the 1st of December 1883, the groove of the caisson was drawn up to the tongue of the pier-end; the water was then let in, and in six minutes the caisson settled down upon its bed; and by the 8th of January 1884, the filling of the tank with concrete was completed. A heavy sea tore away 50 feet by 14 feet of the seaside of the plating, leaving a gap which was filled up in five days by one hundred and seven 10-ton concrete bags. The completion of the pier-head was deferred, after being raised to the service-road level, till the landing stage had been constructed. The outside circular blocks were then raised to the floor-level, and the interior was filled with concrete-in-mass; in the following season, 1884-5, the pier-head was surmounted by a 7½-foot parapet.

Landing-pier.—A landing-pier projects from the pier-head, 120 feet long, 21 feet broad, 37¾ feet deep, and founded 24 feet below low-water Fig. 8. Being sheltered by the breakwater, it is provided with landing-stairs, for the light-keeper to have access in all seasons. The blocks, nine hundred and twenty in number, were set in forty-nine days by a 7-ton overhead travelling-crane from a timber stage erected as shown on the section; and 186 cubic yards of concrete-in-mass were laid on the top. The total cost was £7,039.

Lighthouse Tower.—A circular tower, 36½ feet high, was erected on the pier-head, built of a moulded concrete-in-mass basement and concrete blocks above; it carries a second-order light with its focal plane 58 feet above low-water Fig. 9. The external diameter of the tower below the coping is 17 feet, and the internal diameter is 11 feet. The lighthouse contains an oil-room at the base, over which are a store-room, a bed-room, a living-room, and a watch-room, with concrete floors supported on rolled iron joists, and a cast-iron staircase.

(To be continued.)

TRADE DEPRESSION SUMMARISED.—Briefly summarized the answers to the questions put to witnesses before the Royal Commission were:

(*a*) That the trade and industry of the country are in a condition which may be fairly described as depressed.

(*b*) That by this depression is meant a diminution, and in some cases an absence, of profit, with a corresponding diminution of employment for the labouring classes.

(*c*) That neither the volume of trade nor the amount of capital invested therein has materially fallen off, though the latter has in many cases depreciated in value.

(*d*) That the depression above referred to dates from about the year 1875, and that, with the exception of a short period of prosperity enjoyed by certain branches of trade in the years 1880 to 1883, it has proceeded with tolerable uniformity, and has affected the trade and industry of the country generally, but more especially those branches which are connected with agriculture.

The Gazettes.

PUBLIC WORKS DEPARTMENT

India, March 12, 1887.

The services of Major J. L. Macpherson, R.E., Executive Engineer, 1st grade, sub. *pro tem.*, North-Western Provinces and Oudh, are replaced at the disposal of the Military Department, with effect from the 21st February 1887, the date of expiry of his furlough.

Mr. M. J. Harman, Executive Engineer, 3rd grade, State Railways, is transferred from the Establishment under the Government of Madras to that under the Director-General of Railways.

Mr. W. E. Muntz, Assistant Engineer, 2nd grade, is transferred from the Punjab to Burmah for employment on Provincial Works.

Major G. F. L. Marshall, R.E., Superintending Engineer, 3rd class, *temporary rank*, Under-Secretary to the Government of India, Public Works Department, is promoted to Superintending Engineer, 3rd class, *special*, with effect from the 10th December 1884, and to Superintending Engineer, 2nd class, *temporary rank*, with effect from the 7th March 1886.

Captain B. Scott, R.E., Executive Engineer, 3rd grade, State Railways, is appointed Deputy Consulting Engineer to the Government of India for Guaranteed Railways, Calcutta.

The Governor-General in Council is pleased to order the following promotion and reversions, with effect from the dates specified :—

Colonel D. Ward, R.E., from Chief Engineer, 3rd class, to Chief Engineer, 2nd class, with effect from the 6th December 1886, temporary.

Lieutenant-Colonel T. C. Manderson, R.E., from Superintending Engineer, 2nd class, to Superintending Engineer, 1st class, with effect from the 6th December 1886, temporary.

Lieutenant-Colonel T. C. Manderson, R.E., from Superintending Engineer, 1st class, *temporary rank*, to Superintending Engineer, 2nd class, with effect from the 11th December 1886.

Colonel B. Lovett, C.S.I., R.E., from Superintending Engineer, 2nd class, *temporary rank*, to Superintending Engineer, 3rd class, with effect from the 11th December 1886.

Mr. H. Johnson, from Superintending Engineer, 3rd class, *temporary rank*, to Executive Engineer, 1st grade, with effect from the 11th December 1886.

Railways.

Director-General of Railways' Notification, dated 11th January 1887, posting Captain G. K. Scott-Moncrieff, R.E., Executive Engineer, 4th grade, temporary rank, to the Toungoo-Mandalay Extension of the Burmah State Railway, is cancelled.

With reference to Public Works Department Notification, dated 5th March 1887, Mr. M. J. Harman, Executive Engineer, 3rd grade, is posted to the Bellary-Kistna State Railway.

Mr. E. F. Gordon, Assistant Engineer, 1st grade, is, on return from furlough, posted to the Toungoo-Mandalay Extension of the Burmah State Railway.

Central Provinces, March 12, 1887.

With reference to Notification, dated 1st March 1887, Mr. G. G. White, Executive Engineer, surrendered, and Mr. C. O. Leefe, Executive Engineer, assumed, charge of the Hoshangabad Division, on the forenoon of the 26th ultimo.

Mr G. G. White, Executive Engineer, availed himself of the privilege leave granted him in Notification, dated the 1st instant, on the forenoon of the 27th ultimo.

N.-W. P. and Oudh, March 12, 1887.

Irrigation Branch.

With reference to Government of India, Public Works Department, Notification, dated 4th March 1887, Colonel W. Jeffreys, R.E., received charge of the Office of Chief Engineer and Joint Secretary to Government, North-Western Provinces and Oudh, in the Irrigation Branch, from Colonel J. G. Forbes, R.E., on the afternoon of the 8th March 1887.

In continuation of Notification, dated 21st January 1887, Mr. H. G. Boyce, Executive Engineer, 4th grade, sub. *pro tem.*, is posted to the Eastern Jumna Canal.

Madras, March 12, 1887.

The following reversion is ordered:—

Mr. J. J. Whitely, to Assistant Engineer, 1st grade, from 8th February 1887.

The following promotions are made from 9th February 1887 :—

Mr. G. D. Wybrow, to be Superintending Engineer, 3rd class, temporary rank.

Mr. J. W. Martin, to be Superintendent of Works, temporary.

Mr. J. J. Whitely, to be Executive Engineer, 4th grade, temporary rank.

Mr. C. J. Peters, to be Executive Engineer, 1st grade, sub, *pro tem.*

Captain L. Langley, R.E., to be Executive Engineer, 2nd grade, sub. *pro tem.*

Mr. A. S. Russell, to be Executive Engineer, 3rd grade, sub. *pro tem.*

Mr. C. J. Ussher, to be Executive Engineer, 4th grade, sub. *pro tem.*

Mr. J. H. Medlicott, to be Executive Engineer, 4th grade, temporary rank.

Assam, March 5, 1887.

Mr. J. W. Buyers, M.I.C.E., Engineer-in-Chief, Bengal-Assam State Railways, on transfer to Burmah, made over charge of his office to Mr. E. J. Moore, Executive Engineer, 1st grade, sub. *pro tem*, Bengal-Assam State Railways, on the afternoon of the 18th February 1887. Mr. Buyers reported his departure for Burmah on the forenoon of the 19th February 1887.

The undermentioned officer has been granted by Her Majesty's Secretary of State for India permission to return to duty, as advised in list, dated the 4th February 1887 :—

Mr. W. H. P. Sherman, Executive Engineer, within period of leave.

Bengal, March 16, 1887.

Establishment—Railway.

Mr. A. Greenlees, Executive Engineer, 4th grade, temporary rank, Dacca State Railway, is granted nine months' furlough with the necessary leave, with effect from the 17th March 1887, or such date as he may be permitted to avail himself of the same.

Burmah, March 5, 1887.

With reference to Notification, dated the 14th January 1887, Mr. W. R. Gilbert, Executive Engineer, 3rd grade, sub. *pro tem.*, made over, and Mr. M. R. Lackersteen received, charge of the Arakan division on the 25th January 1887.

With reference to Notification, dated the 31st January 1887, Mr. A. H. Broun, Assistant Engineer, 2nd grade, joined the Pegu division on the forenoon of the 11th February 1887.

With reference to Notification, dated the 13th December 1886, Mr. H. W. James, Assistant Engineer, 1st grade, reported his return to duty from privilege leave on the 28th February 1887. Mr. James is transferred from the Minbu-Mindôn road to the Pyinmana (Ningyan) division

With reference to *Gazette of India* Notification, dated the 18th February 1887, Mr. J. D. Grant, Executive Engineer, 1st grade, sub. *pro tem.*, reported his arrival at Rangoon on the forenoon of that date and is posted to Upper Burmah for the purpose of inspecting irrigation works.

With reference to Director-General of Railways' Notification, dated the 11th February 1887, Mr. W. Wiseman, Executive Engineer, 2nd grade, is posted to the Fourth Division, Toungoo-Mandalay Extension of the Burmah State Railway.

Punjab, March 10, 1887.

Mr. A. Grant, Assistant Engineer, 1st grade, has passed the Departmental Standard Examination in Hindustani.

Irrigation Branch.

Mr. F. Harris, Executive Engineer 4th grade, Sirhind Canal, is allowed 2 years' furlough to Europe.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

March 1, 1887.

151 of 1886 —George Gauthier, Silk Spinner of Hazaribagh, in the Province of Bengal, amended specification of his invention for new processes and new applications of existing processes.—*For all descriptions of cocoons in the stifling, disintegrating, boiling, steaming and reeling into raw silk or tram.*

170 of 1886.—Pieter Van Gelder, of Sowerby Bridge, in the County of York, in the Kingdom of England, Milling Engineer.—*For improvements in apparatus for washing or damping and drying grain.*

172 of 1886.—The Simonds Steel and Iron Forging Company, Limited, of London, England.—*For improvements in methods and machines for making irregularly shaped metal articles that are circular in cross sectional area.*

236 of 1886.—Walter Thomson, Zemindar, of Beheea, Shahabad, Bengal, and James Bingham Alliott, Engineer, of Nottingham, England. —*For improvements in centrifugal machines or spinners for draining sugar or other purposes.*

21 of 1887.—Alfred Steer, of 3, Shornden Terrace, Bohemia Road, St. Leonards on Sea, in the County of Sussex, Artist.—*For improved means for facilitating the checking of cash received.*

30 of 1887.—Henry Campbell, of 19, Soho Square, in the County of Middlesex, England, Engineer.—*For improvements in apparatus for making wooden boxes.*

34 of 1887.—Johannes Spiel, of Berlin, in the Empire of Germany, Engineer.—*For improved supply valve gear for petroleum or gas engines.*

36 of 1887.—Stefan Siemang, Lieutenant of Artillery, and Adalmar Breden, Captain of Horse, both of the City of Vienna and Austrian Empire.—*For improvements in universal hydrocarbon lamps or lanterns.*

37 of 1887—Berkeley Deane Wise, of Belfast, Ireland, Civil Engineer.—*For improvements in train staffs for working single line railways and tramways.*

43 of 1887—Edward Smith and Frederick Smith, of Hatton Garden, London, England, Designers.—*For an improved method of producing ornamental decorations, transparent or other.*

44 of 1887.—Frederick Spencer Delves Broughton, of Dagus Mines, Elk, Pennsylvania, United States of America, Civil Engineer.—*For a method of locking nuts.*

Notices.

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CONTENTS.

Obituary.

DE PREE.—18th February, at Jersey, Colonel George Charles de Pree, Bengal Staff Corps, Surveyor-General of India.

HOWES.—21st February, at Balham, Major-General F. A. Howes, Royal (Madras) Engineers, Retired, aged 51.

NEWLYN.—At Lucknow, on the 12th March, Peter Newlyn, for many years P. W. Inspector, G. I. P. Railway, and Clerk of Works, O. & R. Railway, Lucknow, aged 62 years.

INDIAN ENGINEERING.

SATURDAY, MARCH 26, 1887.

IRRIGATION WORKS IN BENGAL.

THE last number of the *Gazette of India* contains a Resolution of the local Government on the Canal Revenue for the official year 1885-86, which gives some interesting particulars in connection with the working of the system throughout the Province. It appears that at the close of the year under review, the total capital outlay on canals including indirect charges has been Rs. 6,88,13,181. Of this sum Rs. 7,82,000 has been contributed by the Imperial Government from Protective Grants, such as Famine Relief and Insurance Funds, Rs. 86,52,056 has been provided from Provincial Revenues, and Rs. 5,86,02,070 has been charged to Loan Funds. Besides the items enumerated above there has been an outlay incurred of Rs. 7,77,055 in carrying on surveys for irrigation works, which have not been carried out. There are now, continues the Resolution, in actual operation in Bengal 782½ miles of canal, of which 553 miles are navigable. The total area commanded by these canals is 2,698,846 acres, of which 455,987 acres, producing crops of the estimated value of Rs. 1,13,94,483, were irrigated during the year. The number of boats plying in the canals during the year was 241,951. The total value of goods passing through the canals in boats and rafts aggregated Rs. 8,51,21,950 approximately. A comparison of the revenues collected from and the expenditure on the canals in operation shows that at the end of the year there was a net income of Rs. 6,60,074, but as interest amounting to Rs. 22,49,193 was payable to the Imperial Government, there was a deficit of Rs. 15,89,119 to be met from Provincial revenues. The receipts during 1885-86 show an increase over that of the previous year or of 1883-84, but this was owing exclusively to the collection of arrears of water rates due for past years and not to enhancement of revenue; for we find from a tabular statement furnished in the Resolution that while in the year under review the receipts aggregated Rs. 19,70,600, those for 1884-85 amounted to Rs. 22,45,050. This continual accumulation of large balances on account of water rates, had attracted the attention of the Imperial Government as well as of the Secretary of State, and when in 1884-85 it had reached the enormous sum of nine and a quarter lakhs, that is, more than 40 per cent. in excess of the outstanding balance of any former year, the Lieutenant-Governor was compelled to bring to the notice of the several Commissioners of Divisions this undesirable state of affairs, and to insist on their using more sustained efforts in the collection of Canal Revenue. Although Sir Rivers Thompson approves of the results so conspicuous in the Sone Canal, he yet doubts their correctness, as the following quotation from the Resolution will show :—"The above figures, however, are but an imperfect representation of the facts ; for though they show a large reduction in outstanding balances, they give no indication whether that reduction has been effected by collection of the arrears or by the far easier method of remissions.

The results on the Midnapore Canal, on the other hand, are, both relatively and actually, unsatisfactory It is true that the outstanding balance has been largely reduced; but this result is not so much due to the realization of arrears as to the adoption of the expedient of writing off as irrecoverable, balances as to the collection of which no sufficient investigation was made before the demand was abandoned. In regard to the area irrigated, it would seem that there has been a steady decline during the last three years, one of the principal causes being the falling off in the annual leases on the Sone Canal. On the Orissa Canals there has been an increase in the area irrigated clearly indicating that the former opposition to irrigation in that Province is slowly but as surely dying out, under the pressure of circumstances; and hopes are entertained that in a short time the results will be as satisfactory as those of 1882 when 70 per cent. of the entire area was irrigated. The Calcutta and Eastern Canals come in for their share of praise in the Resolution "as the most productive Public Works in Bengal." More than twenty lakhs have been expended from Provincial Funds in the last ten years on the improvement of these canals The whole of this expenditure is now returning a revenue of 5½ per cent.

BATTLE OF THE MAIN.
II.

THE sum total of the arguments on the question of the tests to which the main should have been submitted lies in a nutshell. The opposition or rather that party in the Corporation which persistently throw obstacles in the way of improvements and cavil at the least deviation from the beaten path, in the absence of more cogent reasons urge that the original specification required a test of 100 feet for 72 hours, whereas the one that had been applied was up to 70 feet and for 4 hours only, and as there were leakages here and there, the trial was in consequence not satisfactory. Those who adopt this line of reasoning forget that the purpose for which the main has been laid is more than sufficiently answered, inasmuch as it brings water into the town without the aid of pressure. If gravitation insures the same end, and the main withstands a pressure higher than in practice it would ever sustain, where lies the necessity of submitting it to a further ordeal? Those who clamour for a pressure test should bear in mind what all competent Engineers who had reported on the matter have pointed out, that it would be much cheaper to lay down a third main and bring in water by gravitation, than merely to serve a hobby of permanently carrying water through the main by pressure. This is borne out by the testimony of one firm of contractors, no mean authority on the subject, who said that to work under pressure would cost Rs. 75,000 for the first year of maintenance. Admitting that it could be worked at a lower figure, it must not be forgotten that every pice of it will have to be screwed out of a community who can ill afford to pay taxes. The remarks made at the meeting by the Hon'ble Mr. H. J. Reynolds are lucid and much to the point. He imagined that it was presumed by Messrs. Kimber and Buckley that the only possible repairs that the test would involve would be repairs to the joinings of the pipes which might be found to leak under pressure. But they (the Commissioners) did not take into account the possibility of the test proving fatal to the main itself, and if such a calamity should happen the loss to the Corporation could only be estimated by lakhs of rupees. He would like to ask on what ground they were going to undertake the possibility of such a thing? He was quite aware that the contingency was a most remote one, but why should they risk even the chance of a thousand to one against them? Why should they subject the main to a test which, if it were to give way under it, would involve them in a fearful calamity, and which would really give them no better knowledge than they had as to what the main would do. Should the calamity actually happen, they would have absolutely no one whom they could make responsible—of course their Engineers would not be responsible. They were not responsible for any flaw in the pipes; and the contractors who supplied the pipes would not be responsible, since the Commissioners had it in their power when the pipes were delivered to test them, had they thought proper to do so. He believed they had not done so. Certainly the contractors would repudiate any responsibility for the pipes after they had been laid, and justly so. On what justification then to themselves and the rate-payers, were they going to risk even the most remote possibility of a calamity so utterly crushing in its effect?

As there could possibly be no reply to this matter of fact view of the subject, the question of testing the main was rightly vetoed by a majority. One word of advice to the Municipal Commissioners and we have done. There is a principle involved in the discussion of this 'main' question, which must not be lost sight of, as it is intimately connected with the efficiency of the Engineering Department; and that is the position occupied by the gentleman in charge of it.

We are sorry to find that some members of the Corporation took a rather attenuated view of the eminent services rendered by him in connection with the scheme. There is no doubt, as we have said above, that he completed the work at a great saving to the public purse, when he might have run up the bill to a much higher figure and yet earned the approbation of the Municipal Commissioners. In the next place, it involved a heavy strain on his time and labour, notwithstanding which one of the Commissioners stooped to observe that if there was a diminution of work would he have accepted reduced pay. The speaker forgot for the time being that there are occasions when the services of a professional cannot be adequately measured by pounds, shillings and pence, but by the much higher standard of public approbation. Mr. Kimber has successfully executed a gigantic task at a minimum cost, but because there happened to be a few leakages here and there in a distance of fourteen or sixteen miles, incidents inseparable from an undertaking of such magnitude, he has the satisfaction of being told that it was done *con amore*, and purely in the discharge of his legitimate duties. A man's talents possess a marketable value, and if he is not treated according to his deserts in one quarter he will naturally transfer them

to another where they are likely to be recognised and appreciated. Undue interference with a man's work begets mutual distrust, and ultimately leads to a strain in the relations of employer and employed, which ought certainly to be avoided if the dignity of the latter is to be upheld. But the disastrous results of such proceedings do not end at this stage, but are carried into the future. When it is publicly proclaimed to the Profession that one of its members has been subjected to contumely others will fight shy of placing themselves in a similar predicament, and neither the Municipal Commissioners nor their constituents will gain by the adoption of such a policy.

SERVICE GRIEVANCES.

WITH reference to our previous article on this subject many of our readers would have us speak more to the point. Our readers are mainly "practical" men. They are men engaged in "construction." Now *construction* is akin to statesmanship. On the other hand, mere criticism is akin to *destruction*. And just as it needs more talent to build a good structure than to pull it down so it is more easy to attack any measure of a Government than to say what should be put in its place.

The difficulty of the case consists in the fact that we cannot as critics or as amateur constructors, propose to the Supreme Government the acceptance of any rigid rules. If the ways of Government could be so ordered then a Charles Babbage who felt himself equal to the construction of a complicated calculating machine could also arrange for us an automatic Viceroy and eke an automatic Council. In plain language we cannot assert that the headship of a department should *never* be conferred on a non-departmental man.

But if it is in the interest—not of a department but—of the public generally occasionally found desirable that a man from a favored Service, departmentally inexperienced, should be introduced into a department, it must occasionally—by the law of averages—be found equally desirable that a man from a department—or it may be a total outsider—should be introduced into that particular Service. No man can honestly assert that this conclusion is either logically unsound or politically inexpedient. As long as the priveleged Services can take occasional outside lucrative appointments, but never lose an inside lucrative appointment, they will naturally continue to preach the administrative propriety of the present unjust arrangement. But if they were required to give up the "heads I win—tails you lose" for a fair "give and take" arrangement then we should presently find Service Secretariats and inspired Provincial Governors struck with the manifest expediency of confining each man to that Service in which his experience has been gained.

Occasionally an individual department—that loses its head and is then supplied with a new head altogether alien in its features and unable to work the wires that send prompt and wise instructions to the legs—articulates its woes in a petition addressed to the Viceroy. The correspondence that ensues between the Supreme Government (S G) and the erring Local Government (L G) may be summarised as follows: S G to L G: "X Y department up in arms *re* alleged injustice—please explain." L G to S G: "Headship of department vacant. Do not think departmental officers have sufficient administrative ability. Don't know them, but presume they have no ability. Have made an excellent appointment—my old friend Z." S G to L G: "'Administrative ability' seems as comforting to you as Mesopotamia to the old woman. Don't like officially to find you guilty but—don't do it again."

When a younger member of the Elect jumps on to an outside department he does so for the sake of the pay. As soon as, by seniority, he finds himself entitled to a post of equal emolument in his own Service he disappears from the department as abruptly as he entered it. Meanwhile, he has for some years been drawing a salary out of all proportion to his years or qualifications. This same salary—in his absence—would have gone to some grey-headed departmental officer whose life has been spent in the department. When the exotic vanishes there vanishes with him any little experience he may involuntarily have acquired while sitting waiting on the department for the coming years to give him the chance of leaving the department without losing his level in rupees.

It is not only, nor perhaps chiefly, as a matter of individual justice that the discretion inevitably and properly allowed to a Local Government should be preserved from degenerating into indiscretion. The good of the Public Service is no way furthered by the capricious appearance and disappearance of this or that fortunate individual in this or that hardworked department. But the chief physician of the hospital in which so many of these sufferers have nursed their woes has lately successfully diagnosed the peculiar complaint called a Service Grievance and has with much judgment entered in the books of the institution suitable prescriptions for the same.

Prescriptions, as we know, are usually expressed in a language "not understanded of the people." But we, as heretofore, will put the matter in the plainer form of an ordinary official "Chit." S G to L G: "The next time you think you have no man in the X Y department fit to take the reins just ask Brown or Smith to lend you a man from his X Y department." Not much knowledge of the human constitution—or may we call it human nature—is needed to show that this little prescription will prove an infallible specific for this virulent and contagious disorder.

OPINION OF THE PRESS.—*INDIAN ENGINEERING* a scientific and illustrated weekly journal, which made its *début* only on 1st January last, has now, we are glad to find, a circulation of over eight hundred copies a week. The subscription for the hebdomadal is so small, that we are not surprised at its rapid success. Each number is an improvement over the previous issue, and the one before us (10) contains much valuable matter regarding the P. W. D Re-organization; the Calcutta Drainage; Proposed Changes in the Bengal D. P. W., Provincial Branch; the Madras Harbour; the Lahore Cathedral, &c. That the Journal has achieved undoubted success there can be no doubt, and we trust it will coutinue to increase in its circulation largely.—***Madras Standard, March* 11.**

Notes and Comments.

The Bolan Railway.—A Correspondent writes:—"The Duke and Duchess of Connaught passed through Quetta to-day (16th instant) and the journey was a successful one."

Raniganj Gup.—Mr. Kenny is coming out again to develop the country adjoining Baragunda. It is stated that the prospects of a larger percentage at this place are very promising. Mr. Kilby is reported on his way out to take up the charge of Cement Works to be worked by a Syndicate.

Services lent and continued.—The appointments of Government Engineers in the Gwalior State have taken place as we predicted. The Government Engineers in the "Midland" continue getting extensions to serve that Company as well as those in the "Bengal-North-Western" and "Southern Mahratta."

Babul Grass.—A Correspondent asks whether *Andropogon involutus* is not a misnomer for *Pollinia Eriomeda*, which is found all along the Himalayas from Mussoorie to Darjeeling—growing at the foot or on the lower ranges of the hills? We are unable to decide, and are only aware of the fact that the latter is considered the best known raw material for paper-making in India.

Non-Government Engineers.—The Civil Engineers outside the P. W. D. are combining to address Government on the subject of the employment of their Engineers on *outside* works and thus entailing hardship on those dependent on the said class of works for a livelihood. The movement is, we learn, gaining weight and force, and over a hundred names have been already registered. We believe that the next step will be the formation of a Committee and the appointment of a Secretary so as to organize the movement.

Irrigation in Hyderabad.—The Nizam's Government is about to depute one of its Public Works Officers to the Madras Presidency with the view to the maturation of a proper scheme for the restoration of the irrigation works of the State. From our own knowledge of the State procedure in respect to some of the irrigation works already executed in the Nizam's Dominions, we think that that the Government should first find the means for carrying out its intentions before seeking for information which is not required and will never be utilised.

Royal Engineers.—The following decision of the Government of India, Military Department, is promulgated for the information of those concerned:—In the case of Royal Engineer Officers who, by their election for continuous service in India whilst on furlough, are brought under the leave rules for the Staff Corps with effect from the date of their election, the period of furlough granted to them under previous rules holds good, but their absence from duty is limited to two years calculated under Staff Corps rule, *i.e.*, from date of leaving their station.

The Royal Military Academy.—Lord Wolseley, addressing the successful Woolwich cadets, in February last, hoped he was not saying anything wrong when he presumed that he was addressing men who meant to make the Army their profession and use it as a means of advancement, hoping to reach through its ranks to a position of eminence and honour. He said that the highest essential for success was zeal in the performance of a soldier's duty, which demanded earnestness, devotion and self-denial, and that they should practise and improve upon all they had learnt at the Academy.

Willesden Paper.—This paper was used in making sheds for silos, in order to see how far it is useful for agricultural needs in this country. It is of different thicknesses, but in this case what is termed two ply was used. It is quite waterproof and stood the whole rainy season very well, but the defects are:—(1) By the heat of summer it gets so brittle that even the small gravel in dust-storms is enough to split it up; hence it is no good for out-door use in this country; and (2) Its price is very heavy—Re. 1 per square yard—nearly as costly as corrugated iron.

Water-lifts for Irrigation.—The last Report of the Director of Agriculture says that the demand for pumps in the N.-W. P. and Oudh is on an increase. It is owing only to their high price that they are not used more freely by common people. Attempts are being made to make them cheaper. It has unquestionably been admitted by practical farmers now that for the places where canal water requires lifting, they are an unequalled appliance. Eleven pumps were sent to canal officers for trial and to make the people acquainted with their advantages. Thirty-one were sold during the period under report against eight during the corresponding period last year.

Irrigation in the Bombay Presidency.—Mr. J. H. E. Hart, C.E., the Chief Engineer for Irrigation, Bombay, in summarizing the financial results of the past year's operations, says that few of the Irrigation works in Western India as much as pay their working expenses. This unsatisfactory state of things is explained as being due mainly to the reduction of water-rates forced on the Department in the year 1883-84, which has given rise, in almost every case, to a loss of revenue, without any great apparent advantages in the shape of extension of irrigation. But in Sind, the results for the year are reported as very satisfactory, the area brought under cultivation during the past few years having increased considerably and showing signs of further expansion.

Frontier Mineral Fuel Prospects.—Both the coal and petroleum found on the Sind-Pishin line have been found sufficiently satisfactory to warrant Government expending some more capital in working them. A survey for a railway line from Baber Kutch to the petroleum mines has been completed and the work will probably be started next financial year. The petroleum is of a coarse kind and the Mining Engineer does not expect to find any of the better sorts in the present locality. People are, however, looking about for indications elsewhere. A trial engine was run some six months ago from Sharig to Hurnai with coal found near the former place and as an experiment was eminently satisfactory. A further trial is to be made to test its weathering capacity and how it will answer in larger quantities.

Professional Advisers.—A Colonial paper asks anent the Maligahakanda Reservoir final failure: On whom are we to lay the blame of this huge and costly blunder? This is what comes of trusting implicitly to so-called eminent men—the Consulting Engineers of the Colonial Office, men who build tanks on the edges of cabook hills and assert that only broad-gauge railways are possible in rough and broken country. It adds: It

is folly, and criminal folly—to follow blindly—as we always do, the advice given by Consulting Engineers who have no local experience. If Mr. Bateman had inspected and himself selected the site, the failure of the tank would be a reflection on his professional ability; but, as it is, it proves the absurdity of following the most eminent engineers absolutely without local experience.

HOUSE ACCOMMODATION IN BOMBAY.—A Committee has been appointed to consider and report upon the question of increased house accommodation for the inhabitants of Bombay. They will not only have to recommend "the distribution of vacant spaces to buildings of various classes, the improvement and construction of roads with reference to future building extension or railway crossings, the prospects of reclamations, reservation of open spaces," and so forth, but they will also have to consider "the question as to the terms which would be likely to attract *bonâ fide* investors in building operations with the best protection for the interests of land-owners, public or private;" and to discuss all such subjects as arise in view "of the rapid growth of a city confined within narrow limits and traversed by two lines of railway."

MEDLICOTT ON THE TRADE OF INDIA.—Few countries in the world can have a more abundant supply of pure iron ores; and in old times iron-smelting was common all over the Peninsula, and Indian steel was famous. The manufacture is now well nigh extinguished by the cheaper product of wholesale methods. In connection with the coalfields and with the extension of railways there is no doubt that these methods might now be profitably started in India. Why did India not manufacture its own glass? The materials necessary existed in great abundance, and the growing trade in European pottery might easily be met by Indian-made goods, and Messrs. Burn and Co.'s admirable examples of this shown at the late Exhibition might be taken as a foretaste of the future. Last year India imported £861,318 worth of chemicals, drugs, and dry stuffs. The bulk of these could easily enough have been manufactured in the country.

THE MADRAS COLLEGE OF ENGINEERING.—The following are the results of the examination for diplomas as Assistant Engineer, which was held by the Board of Examiners in December 1886, the candidates being the students of the senior division of the Madras College Engineer class:—Certificate as Assistant Engineer—Passed with credit—R. Gopala Aiyar, B.A., R. V. Sundaram Aiyar, B.A., A. V. Panchaprakesa Aiyar, B.A.; Certificate as Assistant Engineer—S. Lakshminarayana Aiyar, D. Sesha Charlu, B.A., N. Pranatartihara Aiyar, V. K. Narayana Unythan. The following are the results of the Madras University Examination for the degree of Bachelor of Civil Engineering, which was held in January last:—Second Class—R. Gopala Aiyar, B.A., R. V. Sundaram Aiyar, B.A., A. V. Panchaprakesa Aiyar, B.A.; Third Class—S. Lakshminarayana Aiyar, D Sesha Charlu, B.A., N. Pranatartihara Aiyar, G. V. Subramanya Aiyar. All these are passed students of the College of Engineering.

ELASTICITY AND THE STRENGTH OF MATERIALS.—There is so much confusion in ordinary text-books at the present day as to the use of the terms "stress" and "strain" that it is interesting to note the terminology adopted by the late Dr. Todhunter in his work on "A History of the Theory of Elasticity and of the Strength of Materials," edited by Professor Pearson and recently issued from the Cambridge University Press:—The word *strain* is retained, as first suggested by Rankine, for the purely geometrical consideration of distortion; *stress* is reserved for the dynamic aspect of distortion, as first accurately defined by Saint-Venant. Thus the stress across an elementary plane is the resultant of the actions, whether attractive or repulsive, which the molecules situated on one side of the plane exercise upon the molecules upon the other side, when the direction of these actions traverses the plane. "Tension" and "compression" are not used; in place of them the word *traction* is used, being positive or negative, for a *stretch* or *squeeze*, and indicating the external effort as against stress, the molecular resistance. *Shear* is used for the stress aspect of the current use of that term, while *slide* is adopted for the strain aspect.

SINGLE RAIL TRAMWAYS.—The cheaper laying down of goods in transit on land has long been taxing the ingenuity of inventors to some purpose, as evidenced by the many devices to gain that end put forward for public approval. Mr. W. J. Addis, C. E., Burma, hit upon something novel in transport facilities. His invention takes the form of a single line railway, and can be turned to account on any ordinary road, by laying thereon a single rail ballasted up to the level of the thoroughfare. This single line tramway is available for cars of any kind, which may be run thereon with the addition of one or more wheels to suit the length of the vehicles. These extra wheels from their being exactly central in position, bear nearly all the weight. The side wheels are serviceable in balancing the cars. The invention will, beyond doubt, turn out highly useful wherever there happens to be sore need of cheap and of easy means of communication. Besides cheapness, it has the recommendation of being directly reproductive. Laying a line hardly costs Rs. 10,000 a mile. So simple in construction are the train and cars, that repairs can be effected by ordinary workmen. On already made roads the cost of construction becomes still lower. We have seen the Tramway in operation at Prome, Burma, as far back as 1879, and can certainly say that it is worth consideration in these hard times for business enterprise.

MINING MANAGEMENT.—The grand secret of all success in mining on a large scale is judicious and economical management. This is a matter which, it is to be feared, is much more spoken about than practised. The tendency is, when there is a moderately large amount of capital available, to plunge recklessly into expense in all directions. The returns are lamentably small, and shareholders become tired of perpetually paying calls which never result in dividends. Economy is not understood except where there is very little money to expend, and then it takes the form of merely scratching the ground, or of sinking a few shafts, driving in various directions, and performing those mysterious operations included under the comprehensive term of "developing the property." True economy in mining consists in knowing the proper direction in which to expend the money; and, though this may involve a large outlay even at the very start, it will be found to be the most judicious course in the end. It certainly requires a manager of very considerable firmness, as well as great theoretical and practical knowledge, to adopt a course of this kind—to neglect those showy appearances of work on the surface which read so well in directors' reports, and other delusive documents of the same kind; and to pursue one well defined plan of operations—knowing what to look for, and where and how to look for it.

Current News.

Colonel Filgate, R.E., Accountant-General, Public Works Department, takes six months' leave in July next.

Colonel Sim, Superintending Engineer, Rajputana, acts for Colonel Perkins as Chief Engineer of the Punjab.

The Mysore Gold Mining Company crushed 610-4-5 tons of ore during the short month of February, and obtained 989-4-5 ozs. of gold.

The accident on the G. I. P. Railway near Egatpuri turns out not to have been so serious as was at first reported, but it requires explanation.

Major F. Bailey, R.E., Conservator of Forests, on furlough, is appointed temporarily to be Conservator of Forests in the Punjab, *vice* Mr. Hill.

The Bombay-Burmah Trading Company, we hear, will be allowed to work the Burmah forests as heretofore, paying on the outturn of timber.

The Bombay Jubilee Technical Institute is making fair progress, and both the Mill Owners' Association and the Municipality have given grants-in-aid.

His Excellency the Viceroy will open the new bridge over the Gunduck at Hajipur, on Wednesday, the 30th instant, and not on the 29th, as has been previously announced.

The *Deccan Times* says :—That it is not true that Mr. Syed Ali Belgrami has been appointed to the Inspectorship of Mines. Mr. Syed Ali still holds the post of Director of Public Instruction.

The services of Mr. F. T. Rickards, Assistant Superintendent, Indian Telegraph Department, are placed temporarily at the disposal of the Bombay, Baroda and Central India Railway Company.

The Government of India have sanctioned the estimates for the construction of the Water Tower Works, the Engine and Boiler House, and the Filter Tank at the Gunpowder Factory at Ishapore.

On the afternoon of the 20th instant a goods train engine from Mysore to Bangalore got derailed near Muddur station. The boiler burst, killing the driver, named Rhapson, his brother, a fireman, and an assistant fireman, named Butcher.

Mr H. C. Hill, Officiating Conservator of Forests in the Punjab, is appointed to be Conservator of Forests in Upper Burmah, and to be also, temporarily, *ex-officio* Secretary to the Chief Commissioner of Burmah in the Forest Department, for Upper Burmah.

There was a meeting between General Goodfellow, R.E., Secretary of Public Works in Bombay, and the Hon'ble General Chesney, at Delhi, last week, to discuss and settle some knotty points connected with the Bombay Harbour defence, which were settled accordingly.

Some differences that have arisen between the Government of India in the Railway Department and the contractor for a section of the Bellary-Kistna State Railway, and which have caused considerable delay in the progress of the work, are likely to form the subject of legal proceedings.

The Southern Mahratta Railway authorities are making arrangements to begin the work in connection with the Gubbi-Harihur extension of the line. Large quantities of rails and sleepers are being sent to Gubbi almost daily. Mr. W. L. Buyers, Superintending Engineer, is in charge of this work.

The Government Dockyard at Kidderpore have scored a success in the launching of a new steamer on the 13th instant for the Eastern Bengal State Railway. This steamer is a vessel of 230 feet in length, 48 feet beam over all ; is built of steel, 1,000 indicated horse-power, and calculated, when completed, to steam 15 knots an hour.

Some difficult engineering work has been done already on the Pishin Railway ; but the proposed extension to Chaman, beyond the Khwaja-Amran range, "bangs Bannagher." Between Gulistan-Karez, the present terminus, and Chaman, the line, if tunnelling is to be avoided, will have to be carried up some 2,000 feet to the Khojuck Kotal, and down 1,700 feet on the western side.

Sir Henry Mance has devised a grapnel for lifting submarine cables, which has, in addition to the ordinary pair of prongs, a pair of curved bars which spring from the neck of the grapnel and bend over towards the toes of the prongs, but do not meet these. They serve as fenders or protectors of the prongs on rocky ground, while allowing the cable to be caught on the prongs in the usual way.

Sweeping reductions, we understand, are to be effected from 1st April next in the Public Works Department. The shears of the Finance Committee appear to have reaped the very large harvest, in this department alone, of nearly Rs. 8,00,000. The whole of the temporary establishment, including Executive Engineer Officers, (several of whom are in receipt of pensions from Government,) will be dispensed with.

The following appointments to the North-Western Railway from the existing staff of that line are notified :—Lieutenant-Colonel L. Conway-Gordon, R.E., Director ; Mr J. Lightfoot, Manager, Punjab Section ; Major M. C. Brackenbury, R.E., Manager, Sind Section. Mr. F. F. Hensley, Examiner of Accounts in the Office of the Examiner of Public Works Accounts, Bengal, is transferred to the Office of the Examiner of Accounts, North-Western Railway.

A Mysgis correspondent writes to a contemporary under date the 13th ultimo :—Mr. Jones, of the Geological Survey, has returned from Kalewa, where he went to inspect and report on the coal. His report is not very satisfactory, as he thinks it will not pay the Government to work it to any depth. The seam is ten feet thick, running down at an angle of about 45°, and to work it properly it would require tools and pumps and other expensive plant, in addition to European supervision.

The Governor-General in Council has been pleased to order that the railways, partly constructed and partly under construction, extending from Ruk Junction on the North-Western Railway to Sibi, and from there on by alternative routes *via* the Bolan and Harnai Valleys to Bostan, with extensions to Gulistan and Killa Abdullah, shall be known as the Sind-Pishin Section of the North-Western Railway ; the line Ruk-Sibi-Harnai-Bostan-Killa Abdulla being, known as the main line, the extension to Gulistan as the Gulistan Branch, and the Sibi-Rindli-Darwaza-Quetta-Bostan line as the Quetta loop.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

THE SIND-PISHIN STATE RAILWAY SCANDAL.

Sir,—It is indeed sad to read your remarks on the faulty construction of the Sind-Pishin Railway. I do not see, however, that the Government of India have any one to blame but themselves. They gave the appointment of Engineer-in-Chief to a gentleman, who has a great reputation as a soldier, but who had absolutely no previous railway experience. His staff, also, though at present no doubt comprising many experienced Civil Engineers was, while the great bulk of the work was being done, composed almost entirely of military men drawn from Irrigation, or (worse still) Military Works. It would, therefore, be most unfair to place the discredit attaching to this Railway on the shoulders of the State Railway Branch of the P. W. D.

C. E.

PROVINCIAL PUBLIC WORKS, N.-W. P. AND OUDH.

Sir,—I am sorry to see that Messrs. Richardson and Cruddas have taken umbrage at my remarks made in my letter which appeared in your issue of the 26th ultimo. I quote below the opinion of a friend :—

"'R.' only ventured on an 'opinion' based on a long current uncontradicted rumour, and the general tenor of his remarks were, if anything, favourable towards Messrs. Richardson and Cruddas. The concluding sentences in 'R.'s' letter referred to, do not appear to bear the construction put upon them, as they only dealt with a particular contingency, and 'R.' is as well aware as any one of the capabilities of the *Bombay* establishment of the firm."

I did not for a moment mean to assert that Messrs. R. and C. do not manufacture and supply bridges to the Public Works Department, but the material for them is all of *Home manufacture*, whereas the firm which takes over the Workshops at Rurkee can, if it chooses, extend its operations and *manufacture the material also out here and shape it into bridges, &c., &c.*

The sooner an English firm takes these works over the better.

R.

GARSON'S PATENT SUSPENSION BRIDGE.

Sir,—Leaving those who have time and inclination to deal with "F. E. R.'s" *second* objection, as to the total stress on the end pillar, I may observe that, as the method of solution adopted by "D. E." gives the resultant stresses in every part of the structure, and as the rest of the work is acknowledged to be correct, I am disposed to think that the exception is not valid. This is, of course, only a presumption—to be verified by working out the whole question.

As regards "F. E. R.'s" *third* objection, which refers to the strength of a particular connection on account of deficiency in bearing area, I would point out that the objection is at variance with the result of recorded experiments. In the Transactions of the Institute of Mechanical Engineers, Mr. Browne finds that the breaking load for this particular mode of failure is over 40 tons per square inch. Other experimenters have arrived at similar results—as may be found recorded in the Proceedings of the Royal Society. The lowest recorded experiments that I can remember give the safe co-efficient at about 7 tons for wrought-iron of a quality which will safely bear a tensile stress of 5 tons. I am therefore inclined to believe that the joint in question is quite strong enough, if the pressure on the bearing area is under 7 tons per square inch, as it appears in the present case—if the figures given are correct. "F. E. R's" remark that 4 tons is usually considered sufficient is doubtless an assumption on the side of safety, but I do not consider that this assumption tallies with experience. Cunningham certainly gives 5 tons, but as far as I can remember he quotes no authorities in support ; so I should be disposed to give more weight to the coefficients deduced by the experiments as recorded by the authorities referred to.

F(x).

UNFAIR COMPETITION.

Sir,—It is rumoured that all temporary Engineers in Government employment are shortly to receive notice of dismissal owing

to Government not having work for the new batch of Cooper's Hill men coming out. As there are about 30 temporary men it will be a great relief to Government having these places available; but what are they going to do next year and the year after that? It does seem surprising that they should keep on adding to the Department when they are pressed to find work for those already in it. It is an ill wind, however, that blows nobody any good, and the D. P. W. men have been informed that no one wanting leave will have it refused if it is due him. A number, however, are hanging back till news of the Bengal-Nagpore line to be started is received when they hope to utilise their leave advantageously by taking service with that Company. Already there are over 100 D P. W. Engineers in the employ of Companies, Native States, and Local Boards, and notwithstanding the grave injustice this is to outsiders, numbers of whom are suffering for want of work and promotion through it, Government persist in lending their men to fill these posts. It is hoped the Public Service Commission will take early cognizance of the matter, and in the meantime it is necessary that we as the sufferers should concert measures to show Government that the injustice is felt.

OUTSIDER.

BOILER ACT FOR THE MOFUSSIL.

SIR,—A second meeting of the Mine Managers took place at Raneegunge on the 14th instant to discuss fully and finally the advisability or otherwise of the extension of the Presidency Act to the Raneegunge Subdivision of the Burdwan District. This meeting was rendered necessary by the fact that that held previously was not a conclusive one, and though resolutions were passed unfavorable to the introduction of the Act into the Mofussil, and the excessiveness of the fees, &c., leviable thereunder, it was nevertheless considered necessary to invite the District Magistrate to attend this final meeting when the *pros* and *cons* of the question could be discussed and a definite conclusion arrived at as to the suitability or otherwise of the measure for the mining industry. That officer was formally addressed on the subject, in terms of the resolution passed, and it was hoped that notwithstanding his reply in the negative, as it was "unusual" for an officer of his administrative position to be present at such meetings, he would at least have condescended, at the express and personal solicitations of the representatives of the leading coal owners of the district, to favor the meeting with his presence, when he (the Magistrate) was actually occupying the room immediately above that in which the meeting was held,—but all in vain! The reason assigned is perhaps not *the* reason which induced this functionary to declinecompliance with the wishes of the Mine Managers expressed through their Chairman. For, on perusal of the communications received from that officer, I am able to discover between the lines an implication indicative of a "willing spirit but a weak flesh," induced evidently by the fact that he having already sent in his views to Government, it would have been informal on his part to have acceded to the wishes of the Mine Managers. I am not aware of any restrictions—official or otherwise—being placed on Government officers in attending any meetings to note the discussions arising out of any public question, even though he may be of a diametrically opposite opinion to those expressed at such meetings. However, the meeting, notwithstanding the disappointment, proceeded, and before breaking up passed two resolutions, one expressive of the regret they felt at the non-attendance of the Magistrate of the District, and the other that the Managing Agents or Directors of the various European Companies be requested to memorialise Government on the subject of the proposed extension of Act III. of 1879 (B.C.) to the mining industry, and in the event of it ever becoming law in the Burdwan District, that on the said Companies satisfying Government as to the efficiency of the present control and supervision, which are in almost every case entrusted to Europeans of proved competence and qualifications, that such Companies be exempted from the operations of the said law and the fees payable thereunder. They should further express their willingness to afford any information to the Commissioners to be appointed, or those now in Calcutta, relative to the conditions of all Boilers and Prime movers in use at their various Collieries.

I believe the engines and steam vessels of the E. I. R. at Howrah do not come within the jurisdiction of the Boiler Act, although the Act has been extended to the suburbs of Calcutta.

CARBON.

Literary Notices.

QUARTERLY JOURNAL OF THE GEOLOGICAL SOCIETY OF LONDON. February—1887.

This publication is Part 1 of the *new* volume. It is made up of seven Papers all more or less dealing with Palæontological subjects.

JOURNAL OF THE ASIATIC SOCIETY OF BENGAL. New Series. Vol. XX, No. 4—1886.

This volume is the Natural History Part (Part II.) of the Journal of the Asiatic Society of Bengal, which was issued on the 7th instant. Among the articles which make up the contents we note one on "Solar Thermometer Observations at Allahabad," by S. A. Hill, B. Sc., and another on "Probable Changes in the Geography of the Punjab and its Rivers," by R. D. Oldham, A. R. S. M.

INSTITUTION OF CIVIL ENGINEERS, LONDON.

The first volume of the "Minutes of Proceedings" for the current session is just issued. Besides the Presidential Address, it contains the Papers on "Concrete-Work for Harbours," and that on "The Electric Lighthouses of Macquarie and of Tino," which were under consideration in November and December, as well as articles on the "Constantinople Waterworks," "Effect of Temperature on the Strength of Railway Axles," "Viaduct over the River Retiro," "Formulas for the Weights of Girder-Bridges," "Carron Ironworks," "Belgian Rolled Joists," "Locomotive Engine and Carriage-Sheds," and rather more than the usual number of Obituary Notices and of Foreign Abstracts. The second volume for the session will probably be ready towards the middle of April.

TRANSACTIONS OF THE NORTH OF ENGLAND INSTITUTION OF MINING AND MECHANICAL ENGINEERS. Part I., February—1887.

The opening number of the volume of the "Transactions" for the present year is up to the standard of former issues. Mr. J. Wilson Swan furnishes a Paper on an "Improved Electric Safety Lamp for Miners," and believes that he has gone far towards finding the desideratum of *electric lamps with fire damp indicators.*

Professor J. H. Merivale contributes the results of his investigations on the "Transmission of Power by Steam" with particular reference to underground operations. He says that the special problems that the mining engineer has to solve in a steam transmission are these:—"How many cubic feet of water must be evaporated at bank, and at what pressure, to supply the required power at a known distance from the boiler? What must be the size of the pipes through which the steam is to be conveyed, and the character and thickness of their non-conducting envelope? What precautions must be adopted to provide for expansion and contraction of the steam pipes, and the collection of the water of condensation?" These questions are discussed in a scientific way, and in making comparisons the author does not deny that steam pipes in a pit are more or less of a nuisance, whereas "ropes" are harmless, and "compressed air" is a positive blessing. All that he is prepared to maintain is this, that in all cases that are likely to occur in mines, *steam,* for a distance of 1,200 or 1,500 yards, is as economical as ropes or compressed air, and in some special cases it will be found more economical.

Professor Lebour gives some "Notes on the Coal-measures of Catalonia in Spain." From these we learn that the Peninsula produced, in 1885, nearly 1,000,000 tons of coal, and that with exploratory researches carried on in the light of geological facts, there is good future in store for the country from its coal-deposits.

Mr. M. Walton Brown summarises "An Account of Experiments in France upon the possible connection between Movements of the Earth's Crust and the Issues of Gases in Mines;" and some minor articles complete the "Proceedings."

Among the Abstracts of foreign papers we observe one on Tin-Mining in Perak (Malayan Peninsula) from a French source, affording another instance of borrowing largely without acknowledgment from a work published in 1879 by the Editor of this Journal on the same subject.

STREET'S INDIAN AND COLONIAL DIRECTORY.—The volume of this most useful book of reference for the new year has just been issued. As in previous volumes the information has been collected and arranged with much care; but many additions have been made in the present issue. The work keeps pace with the rapidly developing colonial settlements; new towns and cities are brought within its scope, and several of the minor West India islands are now included. Details respecting the railways and other public works are given. There are some excellent maps, and, as it now stands, the Directory has become indispensable in the offices of every merchant and trader, as well as of all Professional men interested in India and our colonies.

General Articles.

THE MADRAS HARBOUR.

Its Construction, Destruction, and Reconstruction.

IV.

We have said that Mr. Robertson agreed with the Madras Committee that a breakwater was the only work from which any real good was to be hoped, but from different reasons. These were, that for an equal sum of money a breakwater would give much more *deep* water shelter than a harbour; that it would create a considerable length of sufficiently smooth water at the coast line to enable boats to land, or to come to jetties; and that vessels could enter and quit more easily from behind a breakwater than through the one entrance of a harbour. He said also that a closed harbour, such as had been proposed by Mr. W. Fraser and Mr. Samuel Perkes, and approved of by Colonel Carpendale, the dissenting President of the Committee, would probably require a breakwater in addition, to keep out the swell. But Mr. Robertson was by no means confident that a breakwater, any more than a closed harbour, would make a permanent harbour at Madras. It all depended, he said, upon two conditions, regarding which not enough was known, namely, the currents close in shore, and the amount of sand in motion at the coast line. The Committee were of opinion, judging from the effect of a series of small groynes which had already been thrown out from the beach at Madras, with the practical result of extending the beach to near the ends of the groynes, that these littoral currents and amount of sand in motion were of such velocity and amount that this extension of the beach seaward could be carried to any extent, and that whether the shore ends were made of open pile work or not, the tendency of motion of the sand towards the outer ends of the piers of a closed harbour would prevail from the very first; that this tendency would go on increasing the longer the work was in operation, and that, "as every portion of motion lost from the line of the shore would lead to a deposit of sedimentary matters, the final shoaling up of the bed of the sea to the outer end of the proposed harbour followed by the shoaling of the harbour itself, would be the inevitable result." Mr. Robertson could not find that there was any real evidence before the Committee as to the littoral currents and amount of sand in motion, and that they seemed to have taken it for granted that these were sufficient to warrant them in rejecting the designs for a closed harbour. "Any tendency to travel in the bed of loose sand which fringes the coast must," he said, "be due to whatever velocity these littoral currents have, combined with that oblique action of the surf, caused by the ocean currents, which I have alluded to in my report on Cochin. These are the two agents at work in moving the sand. If the velocity of the littoral currents is not sufficient of itself to carry the sand along the coast to the north, or to the south, then the withdrawal of the other agent, the surf, would cause the sand to be deposited at any place where the littoral currents alone are at work.

"In short, if there is such an immense quantity of sand in motion on the shore at Madras as to be beyond the power of control by groynes or otherwise—such a quantity as to render probable, as the Committee think, the formation of a fresh beach extending out to the very end of long piers,—then my opinion is, that even a breakwater will not succeed. It would still the surf, and thus remove one of the two agents which move the sand—and I do not think it will have any effect in strengthening the currents. The consequence would be that the sand would accumulate behind the breakwater, and fill up the sheltered spot, unless the littoral current is strong enough to sweep past, with the sand in suspension. The more successful the breakwater in creating quiet water behind it, the more certain would be the destruction of the scheme from silting." The Committee thought that, with a breakwater there would be a certain extension of the foreshore, which would adopt a more abrupt slope than at present. Mr. Robertson said—"Who is to insure that the foreshore will stop at this 'abrupt slope,' and not extend out till it joins the breakwater? I am certain it would,—if there is enough sand in motion to render probable the growth of the beach out to the end of the piers of an enclosed harbour." "I make these remarks, not because I have come to a different conclusion from the Committee, but to show the necessity there is for some more information as to the littoral currents, and the quantity of sand in motion in the coast, before coming to the conclusion that a breakwater is feasible at Madras." And it was only with the proviso that the necessary information was incomplete that he gave his opinion in favor of a breakwater. "I have come to the same conclusion as the Committee, but from entirely different reasons. I have shown that there *may* be as much, if not more, danger from shoaling in the case of a breakwater, as of an enclosed harbour; but, taking all the circumstances connected with Madras into consideration, a breakwater appears to me to be preferable to an enclosed harbour." His reasons have already been given.

By the time Mr. Robertson's report reached India, Colonel G. W. Walker, R.E., appears to have succeeded Colonel Orr as Chief Engineer, Public Works Department, in Madras, and in a memorandum, dated 7th May 1872, on the report (not published) he stated his disbelief of any sufficient action of current and sand to affect either a closed harbour or a breakwater, believing the true objection to a close harbour to be the nautical one of entrance. As complete dates of all the papers are not given it does not appear whether or not this opinion was expressed before Colonel Walker had seen a note of the same year in which Mr. William Parkes, M.I.C.E., put himself forward (the words are his own) to advocate the construction of a closed harbour rather than a breakwater. Mr. Parkes had seen Mr. Robertson's report, and he considered that the design approved of for a breakwater by that Engineer involved an unnecessary amount of material and was, therefore, much too costly, and that a work on the same design as he was then carrying out at Kurrachee, of the same length and in the same depth of water as Mr. Robertson had proposed could be constructed for £650,000, or about one-half of Mr. Robertson's estimated cost, and be finished in four years instead of seven. But he altogether rejected the idea of a breakwater, considering a close harbour to be in every respect preferable, and not admitting any fear of its shoaling, except from the remote possibility of the beach extending to the pier heads and entrance. "When the time does arrive," Mr. Parkes said, "posterity will no doubt be in a position to grapple with the difficulty." Mr. Parkes, however, admitted that there are no definite means of judging of the amount of accumulation that would take place, and that nothing short of experiment could conclusively decide the question, and he, therefore, recommended that a solid pier should be run out from the shore into 20 or 25 feet of water, which "would bring the question to a practical test by showing how much would be collected in a single season." The pier would form part of the harbour if the result of the experiment was encouraging. This was in fact Colonel Carpendale's proposal. But as it was already known from the action of groynes already constructed that the seabeach could be extended seaward for a considerable distance in one season, and the doubt was how far this extension would reach in a long series of years, the practical nature of Mr. Parkes' proposed test for one season only is not apparent. 20 to 25 feet depth of water is found at from 1,100 to 1,400 feet from the shore, and Mr. Parkes, only a year afterwards, after examining the records regarding the effect of the groynes in the Chief Engineer's office, calculated that a triangular area between the coast and the outside of a pier extending say thrice that distance, or to 1,200 yards from the


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SHEWING
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RAILWAY TERMINUS.
SITE FOR BLOCK GROUND
AND CONCRETE MIXING STATION.
FUTURE QUAY AND SITE WAREH
3 Fm
4 Fm
5 Fm
6 Fm
7 Fm
8 Fm
1000
500
0

shore, would not be filled up in less than 180 years. The longest groyne that had been constructed appears to have been about 400 feet in length, but the rate of advance of the foreshore of course decreased as the depth of water increased. The result of this calculation Mr. Parkes found to be so completely in accordance with the experience at other places, *e.g.*, Great Yarmouth, Bayonne in the Bay of Biscay, and Port Said, that he had no longer any doubt that the accumulation of sand would not be so rapid as to cause any practical inconvenience to a harbour formed by piers running out from the shore. As we shall next see, the experiment was made, in the course of constructing the harbour, and by the 10th of September 1878, by which date the south pier had been constructed to nearly 1,400 feet from the shore, all work was stopped owing to an accumulation of 10 feet of sand at the pier head. But the sand difficulty had been overcome by the north pier in the preceding January, and in November 1879 Mr. Parkes stated that it had not since re-appeared there in any form, and that the soundings taken from time to time proved that beyond the four fathom line there was no disturbance whatever of the bottom. At the south pier the difficulty was overcome during the latter half of 1878 by sinking the concrete blocks through the sand, and by the end of March 1879 a further length of 539 feet of that pier had been set, and a depth of 5 fathoms reached. During 1879, Mr. Parkes said, there had been no difficulty. "Not a grain of sand has shown itself at the foundations of either pier." And within the harbour the coast line had remained entirely unaltered since June 1877, by which time it seems to have advanced 100 feet. The cause of this was that during 1876 and 1877 the south pier was not carried out nearly so far as was the north pier. The result was an area of 18 acres of land gained within the harbour. Ultimately the shore adjoining the north pier and outside of it was extensively eroded, and much outlay required for the purchase of land and compensation and for protective works. Outside the south pier 70 acres of land were gained and partly utilised. In March 1884 the high-water line outside the harbour on the south side was nearly continuous with the two-fathom contour inside, and Mr. Parkes predicted that two years and a half later it would be about 100 feet further out. In the progress reports for 1886 the sand difficulty does not seem to be mentioned, but the erosion on the north side of the harbour goes on; and the local mind is not at ease on the whole subject of the harbour, for in November last a proposal was made to cut away the shore ends of both piers, and allow the littoral currents to have free course. The existence of the Royapuram quarter of the city, and of the station of the Madras Railway Company seems to be threatened.

(To be continued.)

NOTE ON PORTABLE RAILWAYS.

BY LT.-COL. S. S. JACOB, EXECUTIVE ENGINEER, JEYPORE.

THE principle on which the system is based is the distribution of the load on a number of small light wagons, scarcely ever carrying more than 10 to 15 cwt. each. This permits the employment of a light rail, so that two rails firmly fixed to steel sleepers are perfectly portable for one or two men, and being firmly connected, require no further adjustment when placed on the ground for immediate use.

The weight of all the pieces, including wagons, is kept within such a limit that each piece can be removed by men without the aid of any mechanical appliance.

The advantages and economy which would be realized in time of war by having a good supply of portable railway have been explained fully in a memorandum, which I have already submitted at the request of the late Commander-in-Chief, Sir Donald Stewart, to Sir Charles MacGregor. It will be unnecessary, therefore, to allude to this phase of the question (although it is an important part of the proposal) beyond pointing out that portable railways have been adopted by the Russians in their recent wars, and that it forms, I believe, a part of the war material of the French and German armies.

The advantages of being able to bring up reinforcements 100 miles a day from the base, fresh for action with food and ammunition with them for immediate use, is self-evident; it might decide the fate of a campaign.

The great expenditure incurred by our own Government in the last Afghan war in transport and compensation for loss of animals alone, would have been sufficient to provide for many miles of portable railway which after the war would have remained the property of Government. Similarly, the heavy outlay in every famine which has occurred hitherto has been for transport; expenditure which might have been in great part saved, if portable railways had been available *ready to meet the emergency*. It is this that constitutes the great advantage of having a good supply of portable railways and rolling-stock in the country ready for immediate use, *viz.*, the possibility of being able *to use it promptly in time of war or famine*. Both in war and famine saving of time means saving of money, and often the saving of life, and I would urge most strongly the subject to the attention of Government.

Viewing the subject merely from the standpoint of preparation against famine, the chief points in its favour are—

(1) that it does away with the necessity of bringing food for and maintaining alive draught cattle;

(2) that it affords labour of not a severe character for famine coolies;

(3) that it takes grain speedily to famine tracts;

(4) that it saves much of the ordinary famine outlay;

(5) that the more it is worked the better it pays; that the carrying capacity is practically only limited by the rolling-stock available; whereas heavy work may cause the collapse of draught animals, and so loss of life.

To show the probable saving that would be gained by the use of a portable railway in a famine, let us suppose a district of 20,000 persons to be fed; the food centre being, say, 50 miles from the nearest railway. The daily amount of food required would be, say, 40,000lbs. = 5,000 maunds. Allow each bullock cart to take 12 maunds and to do the journey there and back in six days and to cost one rupee per diem. Considering the difficulty of getting forage at such a time I do not think the charge would be less. Then the cost per maund would be Re. 0-8-0, and supposing so many carts were available, the daily cost of carriage would be Rs. 2,500.

Taking the case of a portable railway.

The distance would be divided into, say, six stages of about 8 miles each. Two men could push a wagon this distance and bring back the return empties, and each wagon could take 12 maunds of grain, and it could be conveyed the 50 miles in one day. The cost would be Re. 0-4-0 per maund, and the daily cost of carriage for 5,000 maunds would be Rs. 1,250, shewing a daily saving of Rs. 1,250 in favour of the portable railway. If the famine lasted six months, this would represent a total saving of Rs. 2,25,000. Rails weighing 22lbs. to the yard suitable for locomotives on a 2-feet gauge cost in Bombay without sleepers about Rs. 3,500 per mile. So that the above saving would represent the cost price in Bombay of about 64 miles of 2-feet railway.

If the population to be fed was more, or the duration of the famine longer than six months, or the distance of the food centre greater than 50 miles, ordinary carts might fail altogether, whereas all three would tell in favour of the railway and the saving would be increased in proportion, and who can say that any one of these three conditions might not occur, if all three did not occur together? The advantages in time of war or famine are, in fact, so apparent that it is unnecessary perhaps to say more.

The question is whether it is advisable to incur the expenditure in anticipation of a demand which may not occur for some time. If the material was allowed to lie

idle of course it would be a serious matter and might easily be proved to be a dead loss. This, however, is an argument which might be applied with equal force to any railway or against investing in any war material before war was declared. If it was possible to lay down 50 or 100 miles of portable railway at a month's notice, perhaps it would be unnecessary to do more than decide that this should be done when the occasion demanded, but the objections to such a course are that, considering the routine which is necessarily a part of our system of Government, such prompt action is not to be expected, the proof of its necessity would have to be clearly established before the outlay would be sanctioned, and even then, it is not probable as much material, as would be required, would be ready for immediate shipment, and any deficiency in supply would be fatal to success; and the knowledge, moreover, that it was the intention of Government to import a portable railway might prevent other means of transport coming forward. The material would probably cost more when bought in this way, and it is certain there would be delay. In famine as in war delay means ruin. These are all points which I think deserve serious consideration beforehand, and shew the necessity of having a good supply of portable railway and plant in the country available for immediate use.

There is no reason, however, why a portable railway should not be earning a fair profit on its own account in ordinary years, when it is not required for war or famine purposes. Sir Edward Buck has alluded to the transport of forest produce as perhaps one of the best uses to which it might be put, and as one which would suffer least by its temporary removal for war or famine.

There are other uses which may be suggested. The Customs Department, the Commissariat, in Forts or Arsenals for transport of heavy material, for landing stores, in the Public Works Department for bringing material from quarries or mines.

To shew that there are grounds for this suggestion, it may be mentioned that portable railways have been used on some of the large works in the Jeypore State by the Executive Engineer, and that the returns show an estimated saving of about Rs. 29,000 on a capital of Rs. 1,24,709, besides the fact that work which was urgent and had to be completed within a limited time was successfully performed and could not have been done within the time by other means.

The chief use, however, which I would suggest portable railways should be put to is as feeders to existing railways in districts, where it is not possible at present to lay a more expensive line, and where either from pilgrims or produce there would be sufficient to bring in a fair return on the capital. It would thus serve as a pioneer line to test the capabilities of a district for a permanent line, and would help to increase the returns on existing lines.

The success of such a scheme depends upon having sufficient work for the line. The fact that hundreds of miles of it have been manufactured within the last few years and exported to all parts of the world, and that wherever it has been tried it has given satisfaction, speak much in its favour.

It can carry almost all the articles which a heavier line carries, and can be taken to places where other lines cannot be taken except at great cost. If the articles, such as heavy or long logs, are too much for one wagon, then two wagons can be coupled at the required distance apart. It can be laid on an ordinary metal road, or on a kutcha road, it can cross nullahs or ravines by means of a small earthen bank or by a single girder or beam, and it does not require ballast even, unless when required for locomotives. By inclined planes a branch also can be taken off at any point without disturbing the main line. If required in a famine district where no roads exist a track can be made for it at short notice and without difficulty, and the making of the track would afford suitable work to those able to work.

(To be continued.)

THE PROTECTION OF INVENTIONS AND DESIGNS BILL,—1887.

By Geo. A. De Penning, M. Inst. P. A.

In confirmation of your comments on the Bill introducing a New Inventions and Designs Act for India, I append the remarks of a Home Paper which came is by a recent mail. From this it is quite clear that the large number of patents now applied for in England in entirely due to the great reduction in the preliminary stamp charges, namely, from £25 to £4 for the first four years. Even this charge or its supposed equivalent of Rs. 40 for the same time of four years would be high for India, if I take into consideration the position of its working classes, its mechanics and artizans, whose means or earnings are proportionately small, and to most of whom this charge would certainly prove a hindrance from obtaining protection for their inventions; besides the difficulty of finding an intelligent capitalist to appreciate and assist in such venture, would only result in the loss of many inventions. Doubtless in proposing this altered schedule of stamp charges on Indian patents, this point has not had the attention and consideration it deserves, and it is very clear from the experience of the English Patent Office, that if we are met with the same liberal spirit, our Act will prove as successful as the Act in England.

Even agreeing with the Legislature, that it is expedient to enhance the total cost of the Indian patent, I would in the interests of the poor inventor suggest the following schedule of charges which I feel sure will prove satisfactory :—

Stamp on application ...	...	Rs.	10
" on specification ...	...	"	10
" on the commencement of	3rd year	"	20
" " "	5 "	"	25
" " "	7 "	"	75
" " "	9 "	"	100
" " "	11 "	"	150
" " "	13 "	"	150
	Total	Rs.	540

This gives the same total of Rs. 540 as in the schedule of the Bill, but it makes the preliminary charges much easier while it gives time to the inventor to test or prove the value of his invention, as well as to arrange with a capitalist or friend to carry it on, if it is worth while or pays. The option of course should also be given him to pay up at any time the remaining fees, or two or more instalments if convenient. This may be done by stamps attached to his patent and the registry of the fact in the Patent Office.

The other stamp charges or fees may remain unaltered, since they only affect good or paying patents.

In some respects the proposed Bill is a great improvement upon the present Act, still a few objections may reasonably be taken to some of the sections or provisions thereof. Section 5 (sub-sec. IV) gives power to call for drawings and even models. Although drawings are not always necessary, yet no one would object to the adding of a drawing to applications filed where the invention is hidden in obscure language, or where it is not clearly or sufficiently defined; especially in those cases where it is drawn up by the inventor himself, who from want of usage in wording such documents, generally fails to describe the invention accurately or clearly.

Inventors would willingly send in a rough drawing or sketch of their invention with the application, if it were clearly understood that they were not bound to its exact details, nor to its full description, which is required of them 6 months later, in the complete specification. This time is expressly given on the well-considered principle, that new inventions being crude and incomplete, some time is necessary and required to perfect them, that they may then be fully described and clearly illustrated by drawings. It is to be hoped also that some rules will be laid down to restrict the size and number of drawings to each invention. I have filed some that are more than a yard

square, while others have more than a dozen forms of one machine.

As regard models, many inventors of their own accord have sent in models of their inventions, but these I am sorry to say have not been appreciated, as they are put aside or heaped up in a corner of the Patent Office, where they are falling to pieces from want of care. If properly cared for and well placed on tables, or on shelves in a distinct suitable room or museum, the collection would in time prove valuable and most interesting, so that many inventors would be induced to add to them as the exhibition would show or prove the utility and worth of their inventions.

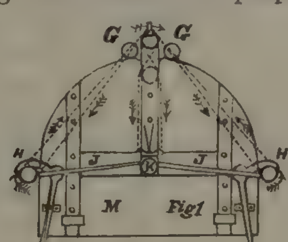
The power to call for models is very arbitrary and comes hard on the inventor, as they may be expensive and require much time to make, or the inventor may be so placed in some locality where there are no means of making one, he would have to move to some position where he could get the model made, as it may need his personal supervision. Besides models are not necessary to illustrate an invention; the first application may be insufficient, and the drawing, if any, may be faulty; but this could be remedied. Such defects, however, would not occur where the application is drawn up by an expert used to the work, who from his experience would readily and clearly describe the invention in such clear or technical language, that the invention, whatever its nature, would be correctly made thereby or reproduced therefrom. Supposing, however, that there are special or extraordinary cases where models are absolutely necessary to understand an invention clearly, then Government from the great increase of fees accruing from the new Bill, could well afford the cost, and they should bear it, as it is unfair to charge it to the inventor.

(To be continued.)

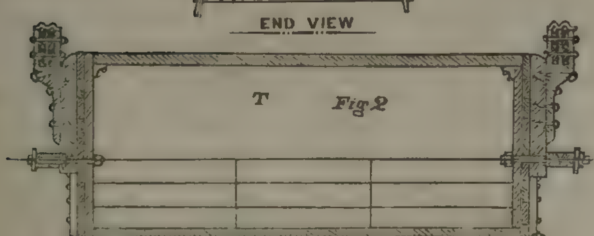
BOYCE'S AUTOMATIC SAFETY COVERING.

THIS is an invention for an improved method and apparatus for applying a covering to railway trucks, cargo boats and the like, whereby the contents are kept safe and wind and water proof, and the covering itself is preserved and guarded against loss.

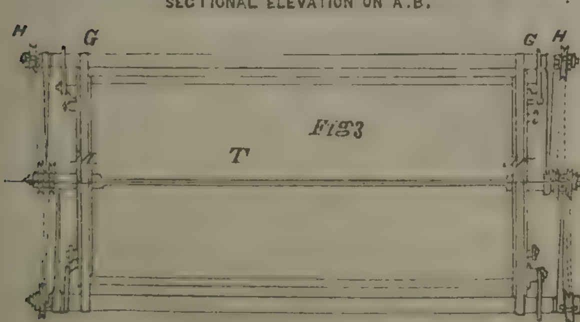
The following description and illustrations show the mode of applying the device for the purposes mentioned.



END VIEW



SECTIONAL ELEVATION ON A.B.



To the two ends of the truck T., Figs. 2 and 3, are fixed an attachment of light iron or wood work, M, M, to the required height in semicircular form—see Fig. 1. Brackets C and D, Fig. 2, carrying two sets of double pulleys and lever fasteners are fitted to the attachments on either end. Two rollers, G, G, G, G, Fig. 3, carrying a paulin or tarpaulin run longitudinally along each side, on the ends of which rollers are pulleys H, H, H, H, Figs. 1 and 3, the paulin or tarpaulin resting on a ridge pole. These pulleys, H, H, H, H., when reeved with rope in connection with the fixed double pulleys, C and D, Fig. 2, form a lift which winds up the cover by means of arms, J, J, working on a radius K, Fig. 1.

The action of uncovering the wagon rolls up the paulin neatly and firmly, exposing only one roll thereof with a perfect drainage, whilst the action of covering the wagon rolls out the paulin fully enveloping the goods.

The advantages claimed for this invention are:—

(a.)—The paulin has no handling whatever.

(b.)—The paulin is rolled up not folded, so cannot crease.

(c.)—Only one fold of the paulin is exposed when rolled up and this has a perfect drainage.

(d.)—The rolled paulin is aired.

(e.)—The paulin is a fixture and cannot be lost.

This method will enable Railways having low-sided trucks, which on open lines are very often "dead stock," to carry covered traffic at a great saving to their capital on stock account, and at the same time to increase the loads on the trains by about one-third of their present composition (the tare of the truck fitted being in the proportion of about two to three of the covered goods wagon), while hauling proportionately a greater load of paying freight.

The cost of fitting a truck with this appliance will not exceed, on the average, Rs. 125, including the paulin, or Rs. 85, without the paulin.

The safety covering can be fitted to each hatchway of an open flat or cargo boat. The cost per hatch will be approximately the same as per Railway truck, and all the advantages which it gives to the truck will be obtained by a boat so fitted, while at the same time the boat when loaded can be sealed or locked against theft of the goods.

The invention is protected—the patentee being Mr. William Charles Boyce of the Superior Revenue Establishment of State Railways in Bengal.

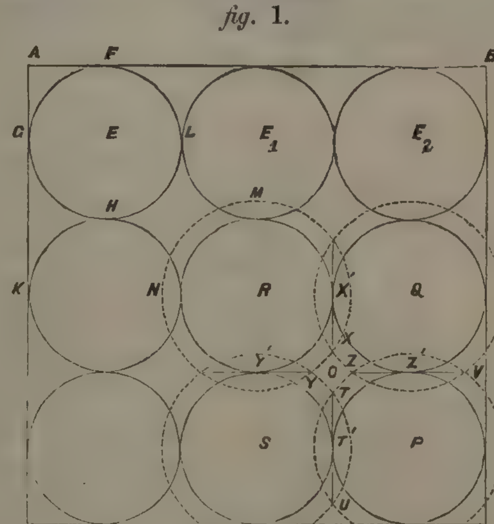
THE CONSTRUCTION OF THE HONEY-CELL;

OR,

THE BEE AND HIS D. P. W.

BY A. EWBANK.

fig. 1.



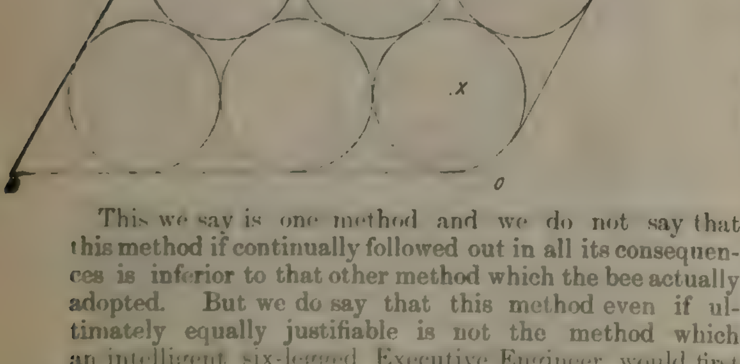
To illustrate these points let us suppose that a hundred animals, bees or bipeds, agree to have their huts together for purposes of industry or defence. Let us suppose that they begin to build houses—either cylindrical with axis vertical, or hemispherical with base horizontal—such as may be indicated roughly in plan by the arrangement of *fig.* 1. We have here nine circles arranged in a sort of square. We could have a hundred circles similarly arranged. Omit for consideration those large circles which are indicated by dotted lines. We have

then a series of circles of the size F G H and we may suppose them built in successive rows of which the first row has for centres E, E_1, E_2, &c. In this case we shall have successive rows of waste spaces built in. In the actual figure we show four of these inner waste spaces, each of the size H L M N. With 100 circles we should have 81 waste spaces. For n^2 circles we have $\overline{n-1}^{\,2}$ waste spaces.

Now a natural idea to a bee or biped is to utilise these waste spaces. Suppose that bees or wasps are building in the hollow of a tree. The total space being limited it is natural to economise every cubic inch. The particular reasons for gathering in these waste spaces may be various and distinct. There may be the wish to save space, *i.e.*, use it. There may be the idea of bringing two cells together to economise material by making one wall common to two cells or there may be the idea of making each cell help to prop up a neighbour. We humans often take a wise step and then discover subsequently that a number of wise reasons might have been advanced in support of the step. But we had not thought of those reasons at the time we made the step. Between the most elaborate formulated argument and the blindest emotional impulse there are a number of intermediate gradations. Reason and impulse blend their forces in many matters of daily life. We often feel that such a course is right or such an argument is wrong before we have formally brought syllogistic premises to bear to establish the rightness of the course or to show the unsoundness of the argument. Therefore we will say that it will come natural to the bee to use up such spaces as H L M N. But we will not at present lay stress on the existence of three separate reasons for his so doing nor will we at present inquire whether one of these reasons was more clearly or dimly prominent than were the other two.

Geometrically—as opposed to engineeringly—there are two ways of utilising the waste spaces. One method is indicated in *fig.* 1. Instead of describing round P, Q, R . . . circular spaces of the size of F G H, let us with the same centres draw larger circles such as are shown by dotted lines. Then that space X′ Y′ T′ Z′ which was equal to H L M N is reduced to X Y T Z. Where two circles overlap, each arc is replaced by one chord such as T U or Z V. Thus each circle has been modified into an eight-sided polygon partly curved and partly rectilinear in perimeter.

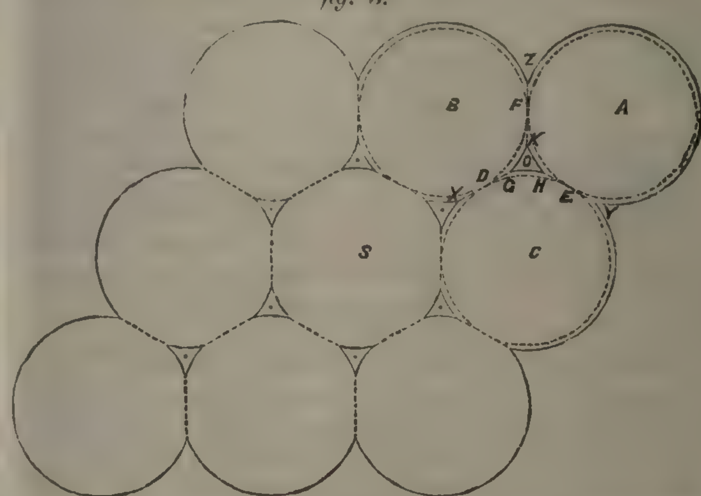
fig. 2.



This we say is one method and we do not say that this method if continually followed out in all its consequences is inferior to that other method which the bee actually adopted. But we do say that this method even if ultimately equally justifiable is not the method which an intelligent six-legged Executive Engineer would first be likely to hit upon. His first idea would be to keep the circles of the original size but dovetail them more into each other. The original size of the cell had some relation to the size of the insect's body, and it would seem more reasonable to shift the cell without altering its size than to alter the size without shifting the centre. This dovetailing process is indicated in *fig.* 2. We may assume that the new trilateral waste space L O P is less than the quadrilateral space H L M N of *fig.* 1. The new arrangement looks more cosy and we may suppose the bees not yet to have "resolved" the driving impulse (which made them dovetail the cells) into those several distinct component reasons which the philosophical historians of their D. P. W. can now marshall before a two-legged public.

But if we compare *figs.* 1 and 2 we discover that the latter arrangement is preferable in a way that has not yet been specified. When the bees in *fig.* 2 are building a second row of cells they get more guidance—as to the position of the new centres and the size of the new circles—from the circles already built—than they would get in the scheme of *fig.* 1. If the bees first adopted the *fig.* 2 arrangement in preference to *fig.* 1 from a mere instinct—so to say—of saving space they would afterwards appreciate the incidental advantage of being able to build their cells more easily and thus more quickly.

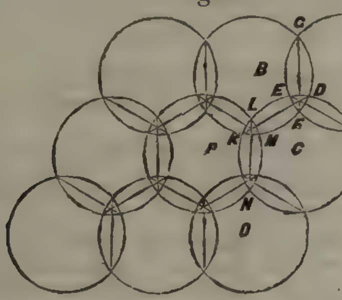
fig. 3.



Thus far our little professional friends have made the best arrangements provided they wish to keep the section of the cell a circle. But now if they are willing to commit themselves to a theoretical—or step by step tentative practical—inquiry as to possible further improvements, there are four distinct reasons which they may sooner or later (as *à priori* motives, or as *à posteriori* justifications) discover for resigning their cherished circles. (1) They can take in the L O P waste spaces. (2) When they bring the walls of two cells into contact they can save material. (3) The cells will mutually support each other. The remaining reason is what I will call the economy of large areas. If in *fig.* 2 the E, Y, S circles are slightly modified so as to share the L O P area between them, the gain in area will more than compensate for the extra use of material even supposing that one common wall did not replace two contiguous ones. If we have a given length of palisading it is more effective in producing area if we make it into six equal circles than if we make it into six equal hexagons. But it does not follow that the total area of the six circles is greater than or as great as, the total area of five or four regular hexagons of the same total perimeter as before. We may however consider this fourth reason to be closely connected with the first reason. We have then the extra space reason, the economy of wall reason, and the stability of structure reason. We will not here inquire which reason would seem most important to the bee; nor which would first occur to him. We need only here consider the actual process. This is indicated in *fig.* 3. A, B, C are the centres of three original cells—as indicated in plan by dotted lines. Thus the area D E F = area L O P of *fig.* 2. If these circles be slightly enlarged their centres remaining fixed they give three common chords GX, HY, KZ. The area D E F is reduced to a smaller area G H K. O is put in the figure for the centre of all such reduced areas. The absorption of the waste areas is here not quite complete.

The bees will therefore in making fresh cells carry this process further until they work with a cell radius equal to A O. Thus the chords GX, HY, KZ increase at each end and G, H, K, ultimatly meet at O. This process carried out with an inside cell such as S and at the same time with all its neighbours, six in number, will result in S losing its circular form entirely and becoming a hexagon.

Fig 4.



In *fig.* 4 we see what would happen if the bees at the first trial made their circles too large. If we imagine them starting with some larger circle chosen at a venture they would get puzzled over their boundaries. But as a matter of fact they worked experimentally—tentatively—step by step—gradually increasing their circles until these had all changed into regular hexagons and then the bees made no further changes.

Referring again to *fig.* 1, we see that if the bees had not first thought of dovetailing their circles into each other, but had commenced by enlarging the circles—kept stationary as regards their centres—then the enlargement of four contiguous circles such as P, Q, R, S, would give us four chords, of which the halves were XX′, YY′, ZZ′, TT′. As the enlargement of the circles proceeded these chords would bring the points X, Y, Z, T, to the centre O. This change taking place everywhere each inside cell would have become a square. Now the square cell is a tolerably satisfactory solution and we notice that another D. P. W. (that of the humans) has adopted this shape for its cells or chambers instead of choosing the hexagonal form. We do occasionally see the hexagonal form employed as in drawing-rooms or turrets. This shows that the human cell builders have not been unaware that such a figure as a hexagon exists. And yet they adopted the rectangle.

With a system of square cells there would be to each cell the support of its neighbours. Waste spaces would be excluded. One wall would be common to two cells and thus the saving by putting two cells together would again be 50 per cent. in material. But perhaps it may be thought by the reader that—just as a circle is for a given area more economical of material than a hexagon and a hexagon more economical than a square—therefore the bee had still an interest (economy of material) in choosing perfectly fitting hexagons rather than perfectly fitting squares. It is however a curious fact that the two plans are just equally good. For, in *fig.* 1, we see that if r be the original radius of the cell circle then the circles are finally modified into squares of a side $2r$. In *fig.* 3, the ultimate hexagon is seen to have a side $AO = \frac{2}{3} AD = \frac{2r}{\sqrt{3}}$. Now let P denote some large space which is successively filled first with the bases of a large number of these square cells and secondly with the bases of a suitable number of the corresponding hexagonal cells. Let s be the number of square cells, h the number of hexagons. Then $P = s.(2r)^2$, and also $= h \times 6 \left(\frac{2r}{\sqrt{3}}\right)^2 \frac{\sqrt{3}}{4}$; $\therefore 2s = h\sqrt{3}$. Again, because we postulate a large space P compared with the area of a single cell we may consider that the large number of cells in each case are inside cells, *i.e.*, that each wall does duty twice. Then the material spent on the walls of the squares is proportional to $4 \times 2r.s$ and on the walls of the hexagons is $6h\frac{2r}{\sqrt{3}}$. These are equal since $h\sqrt{3} = 2s$. Thus we see that one plan is as economical as the other. In fact that economy, which we have called the economy of large areas, here balances that other economy which we will call the economy of *form*.

(*To be continued.*)

NOTES FROM HOME.

(***From our own Correspondent.***)

THE *Engineer* gives an illustrated description of an engine manufactured by Messrs. Shand, Mason and Co. This engine is designed to be used especially in hot countries for irrigating purposes, and in case of emergency to be equally efficient as a steam fire-engine. The engine draws its water from a depth of 20 to 25 feet and will deliver through pipes or hose a mile or more.

The results of the experiments recently carried out with the 110½-ton gun are given in *Iron* of this week. Four rounds have now been fired with charges up to 850lbs. of various kinds of powder. These experiments are to be continued, increasing the charge up to 950lbs.

At a meeting of the London and North-Western Railway recently held, it appeared that the Company are now, in deference to the general desire of the community and the wishes of the Board of Trade, replacing the chain brake with the automatic vacuum brake, with which half their stock is now fitted.

A new mechanical contrivance recently publicly tested in Glasgow is mentioned. It is a "Fibre Extracting Machine" and has been exhibited in the premises of Messrs. George Grant and Son, Mile End. The principal advantage claimed by the patentee is that by the use of his apparatus the difficulty of separating the fibre of rhea or China grass from the stem and at the same time discharging the prejudicial gum present in the plant without injury to the fibre is effectually overcome.

One of the tunnels which the City of London and Southwark Subway Company is driving under the Thames near London Bridge is approaching completion, if it has not already reached the Surrey side. The distance from the Middlesex Shaft at Old Swan Wharf is 667 feet and as the shield for driving was not fixed until 28th October last, if follows that six weeks now suffices to drive a tunnel under the Thames. The second tunnel has commenced, and the Company are so satisfied with the work that they have sought powers from Parliament to extend the line beyond the Elephant and Castle to the Swan at Stockwell.

At Liverpool the steamship *Great Eastern* was lately sold by public auction and knocked down for £26,000. It was stated that she was last sold for £16,000. During the last twelve months she has had a thorough overhaul in hull, screw, engines and boilers and has now a Board of Trade certificate of seaworthiness.

The Ambleside Railway Bill was read a second time last night, by a rather small majority. There is a very strong opposition to the scheme and an outcry has been raised in the Press at the attempt in this project of ruining the beauties of the now undisturbed lake district of England. Further efforts to oppose will no doubt be made before a further stage of the Bill be reached.

The works at the Tay Bridge are approaching completion—it is expected that it will be opened for goods traffic in May and for passenger traffic on 20th June when there will be an opening ceremony.

The Institution of Mechanical Engineers are to have their next Summer Meeting in Edinburgh, the members having been invited by the Senatus of the University to meet in their Buildings. Visits will, in connection with this Meeting, be made to the works of the Forth and Tay Bridges.

According to the American Meteorological Journal an attempt is about to be made at St. Augustine, Flo., to sink a 12-inch artesian well to a depth sufficient to obtain water hot enough to heat buildings, pure enough for domestic purposes, and with pressure enough to run heavy machinery. The earth's internal heat is already forced into practical service at Pesth, where the deepest artesian well is being bored to supply hot water for public baths and other purposes. This well supplies daily 176,000 gallons of water heated to 158°F., and the boring is to be continued until the temperature of the water is to be raised to 176.° Heavy machinery is run by artesian well power in many parts of France.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, March 19, 1887.

The services of Mr. W. H. P. Sherman, Executive Engineer, 2nd grade, State Railways, are, on return from furlough, placed at the disposal of the Director-General of Railways.

Mr. H. S. Jones, Assistant Engineer, 2nd grade, State Railways, is promoted to Assistant Engineer, 1st grade, sub. *pro tem.*

Major T. Gracey, R.E., Superintending Engineer, 3rd class, sub. *pro tem*, Engineer-in-Chief and Assistant Secretary, Railway Branch, North-Western Provinces and Oudh, is appointed Special Superintending Engineer and Secretary to the Chief Commissioner in Public Works Department for Upper Burmah.

The services of Captain A. Hildebrand, R.E., Examiner, 4th class, 2nd grade (temporary rank), temporarily transferred from the Military Works to the Superior Accounts Branch, are replaced at the disposal of the Military Works Department.

Mr. F. Sharp, Executive Engineer, 4th grade, Central Provinces, is transferred to Burmah.

Major F. V. Corbett, R.E., Executive Engineer, 1st grade, North-Western Provinces and Oudh, is temporarily promoted to the rank of Superintending Engineer, 3rd class.

Mr. W. Beechey, Assistant Engineer, 3rd grade, State Railways, is promoted to Assistant Engineer, 2nd grade.

Mr. J. Adam, Assistant Engineer, 2nd grade, North-Western Provinces and Oudh, is transferred to State Railways and posted to the Establisment under the Director-General of Railways.

Mr. H. J. Oddie, Executive Engineer, 4th grade, sub. *pro tem.*, State Railways, is appointed to officiate as Deputy Consulting Engineer for Railways, Bombay.

Military Works Department.

Lieutenant G. A. S. Stone, R.E., Assistant Engineer, 1st grade, passed the Departmental Standard in Hindustani, in accordance with Public Works Department Code.

Lieutenant W. G. R. Cordue, R.E., Assistant Engineer, 2nd grade, passed the examination for promotion to 1st grade Assistant Engineer, in accordance with Public Works Department Code.

Director-General of Railways.

Mr. W. H. P. Sherman, Executive Engineer, 2nd grade, is posted to the Tounghoo-Mandalay Extension of the Burmah State Railway.

North-Western Railway.

Mr. W. Michell, Executive Engineer, 4th grade, temporary rank, North-Western Railway, is granted furlough to Europe for 21 months.

N.-W. P. and Oudh, March 19, 1887.

Buildings and Roads Branch.

Mr. F. B. Henslowe, Executive Engineer, 1st grade, is, on return from furlough, posted to the Office of Chief Engineer and Secretary to Government, North-Western Provinces and Oudh, Public Works Department, on special duty.

Irrigation Branch.

Mr. H. S. Wildeblood, Assistant Engineer, 2nd grade, Bhognipur Division, Lower Ganges Canal, passed the Professional Examination prescribed in Public Works Code, Chapter II., paragraph 9 to 11, on the 8th March 1887.

The following reversion, and promotions will take effect from the dates specified :—

Mr. A. M. Fagan, Executive Engineer, 4th grade, temporary, to Assistant Engineer, 1st grade, 10th February 1887, consequent on the return of Mr. Boyce from furlough.

Mr. A. H. Barron, Executive Engineer, 2nd grade, to Executive Engineer, 1st grade, 21st February 1887, sub. *pro tem.*, *vice* Major Macpherson, R.E., retransferred to the Military Department.

Mr. W. J. Wilson, Executive Engineer, 3rd grade, to Executive Engineer, 2nd grade, 21st February 1887, sub. *pro tem.*, *vice* Major Macpherson, R.E., retransferred to the Military Department.

Mr. H. Nelson, Executive Engineer, 4th grade, temporary, to Executive Engineer, 4th grade, 21st February 1887, sub. *pro tem.*, *vice* Major Macpherson, R.E., retransferred to the Military Department.

Mr. H. S. Wildeblood, Assistant Engineer, 2nd grade, to Assistant Engineer, 1st grade, 8th March 1887, sub. *pro tem.*, to fill an existing vacancy.

Mr. A. M. Fagan, Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, 9th March 1887, temporary, *vice* Major Corbett, temporarily promoted to Superintending Engineer.

Madras, March 15, 1887.

The following reversions are ordered :—

Captain L. Langley, R.E., Executive Engineer, 2nd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, from 1st March 1887.

Mr. A. S. Russell, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, from 1st March 1887.

Mr. C. J. Ussher, Executive Engineer, 4th grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade, from 1st March 1887.

Mr. J. H. Medlicott, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, from 1st March 1887.

Mr. J. W. Martin, Superintendent of Works, temporary, to be Executive Engineer, 1st grade, sub. *pro tem.*, from 10th March 1887.

The following promotions are made :—

Mr. J. W. Martin, Executive Engineer, 1st grade, sub. *pro tem.*, to be Superintending Engineer, 3rd class, from 10th March 1887, temporary rank.

D. Falvey, Honorary Lieutenant and Deputy Assistant Commissary Assistant Engineer, 2nd grade (Supernumerary) to be Executive Engineer, 4th grade, from 10th March 1887, Officiating.

Bombay, March 17, 1887.

Mr. H. G. Palliser, M. Inst. C. E., Executive Engineer, 2nd grade, is allowed furlough for one year from such date in April 1887 as he may avail himself of it.

Rao Saheb G. V. Gaystonde, L.C.E., is appointed to officiate as Executive Engineer, Belgaum, during Major E. C. Hart's absence on privilege leave.

Captain W. W. Robinson, R.E., is appointed to act as Executive Engineer, Aden, during the absence of Lieutenant-Colonel Cruickshank, R.E., on privilege leave.

H. E. the Governor in Council is pleased to appoint Mr. G. N. R. Lambert, M. Inst C. E., to act as Superintending Engineer for Irrigation in Sind, *vice* Colonel LeMesurier, R.E., who vacates, on promotion to Major-General.

Mysore, March 12, 1887.

Mr. C. T. Dalal, Executive Engineer, Tumkur Division, is granted privilege leave for 20 days with effect from 19th April 1887, or date of departure.

Mr. V. H. Karve, Executive Engineer, Mysore Division, is granted privilege leave for 15 days from date of departure.

Burmah, March 12, 1887.

With reference to *Gazette of India* Notification No. 37, dated the 8th February 1887, Sirdar Bahadur Bhagut Singh, Executive Engineer, 3rd grade, sub. *pro tem.*, reported his arrival at Rangoon on the forenoon of the 7th instant and is posted to the charge of the Yamèthin Division, Upper Burmah.

Mr. W. R. Gilbert, Executive Engineer, 3rd grade, sub. *pro tem.*, is transferred from the Arakan to the Tharrawaddy Division.

Mr. E. W. Oates, Executive Engineer, 1st grade, is transferred from the Tharrawaddy to the Rangoon Division.

Burmah State Railway.

With reference to Director-General of Railways' Notification dated the 11th ultimo, Mr. W. Wiseman, Executive Engineer, 2nd grade, reported his arrival at Rangoon on the forenoon of the 1st instant.

Assam, March 19, 1887.

Mr. E. L. Gramatzki, Executive Engineer, 2nd grade, and at present officiating as Assistant-Secretary to the Chief Commissioner of Assam in the Public Works Department, and Assistant to the Superintending Engineer, is confirmed in this appointment, *vice* Captain R. O. Lloyd, R.E.

Punjab, March 17, 1887.

Colonel Æ. Perkins, C.B., R.E., Chief Engineer and Secretary to Government, Punjab P. W. Department, is allowed special leave for 6 months.

His Honor the Lieutenant-Governor has been pleased to sanction the following promotions in the amalgamated Engineer Establishment of the General and Irrigation Branches of the P. W. Department, Punjab :—

Mr. F. C. Murray, to be Executive Engineer, 2nd grade ; Mr. G. R. M. Field, to be Executive Engineer, 2nd grade ; Mr. C. Tickell, to be Executive Engineer, 3rd grade ; Mr. F. W. Vyall, to be Assistant Engineer, 1st grade, permanent ; Captain J. W. Thurburn, R.E., to be Executive Engineer, 2nd grade ; Mr J. J. Mullaly, to be Executive Engineer, 2nd grade ; Mr. F. W. Chanter, to be Executive Engineer, 3rd grade, sub. *pro tem.*

The following transfers have been made in the interests of the public service :—

Mr. W. Macdonald, Executive Engineer, 4th grade, sub. *pro tem.*, to the Umballa Provincial Division, which he joined on the 25th January 1887.

Mr. W. Macdonald, Executive Engineer, 4th grade, sub. *pro tem.*, to the Simla Provincial Division, which he joined on the February 1887.

Mr. B. C. Bensley, Executive Engineer, 4th grade, temporary rank, to the Dera Ismail Khan Provincial Division, which he joined on the 1st February 1887.

Mr. C. E. A. Jones, Assistant Engineer, 1st grade, to the Peshawur Provincial Division, which he joined on the 6th idem.

Mr. J. E. Ives, Assistant Engineer, 1st grade, to the Peshawur Provincial Division, which he joined on the 23rd idem.

Colonel Æ. Perkins, C.B., R.E., made over, and Mr. E. E. Oliver received, charge of the office of Chief Engineer and Secretary to Government, Punjab P. W. Department, on the 14th March 1887.

Mr. W. Smith, Executive Engineer, 4th grade, Chenab Canal Division, is allowed furlough to Europe for 1 year.

Mr. J. J. Hatten, Executive Engineer, 3rd grade, is transferred to the Superintending Engineer's Office, Sirhind Canal.

Notices.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Obituary.

DANGERFIELD.—At sea on board the *Assam*, on the 21st March H. Dangerfield, Manager and Engineer-in-Chief, Indian State Railway. (By telegram from Aden.)

INDIAN ENGINEERING.

SATURDAY, APRIL 2, 1887.

OURSELVES.

WITH the view of relieving the pressure on our space we have still further increased the number of pages of the letter-press, which will, it is hoped, enable us to better accommodate contributors.

INDO-EUROPEAN TELEGRAPH DEPARTMENT.

THE popular adage "Peace has its victories no less than war," finds ample confirmation in the Report of the Indo-European Telegraph Department for the official year 1885-86. The glorious, albeit silent, triumphs of science have, in all ages, thrown into the shade the more noisy but ephemeral renown won in a bloody campaign. Heroic devotion to duty, cool intrepidity in the hour of danger, in the absence of the excitement of a battle-field, have uniformly characterized the work of the clerks employed in the Persian Gulf lines; such as we would look for in vain, under any other circumstances, where European agency is dispensed with. The following excerpt from the report tells its own tale, and does not require any embellishment from us:—"Major Wells, the Acting Director, describes in vivid language, the courageous efforts of the Inspectors and Line Guards to restore the communication. The risk to life in crossing snow-drifts is great, and the privations which must be endured, when, after struggling in a bitterly cold temperature all day, the night has to be passed in some wretched hut or even cave, with barely enough fuel and food to support life, can scarcely be imagined. It was after a week of such work that Mr. Hamilton, clerk at Dehbeed, formerly a Sergeant of Royal Engineers, died from inflammation of the stomach brought on by cold and exposure."

During the year under review the capital account of the Line was increased by about £1,000, and stood at its close at £1,129,975. The traffic receipts were £101,115 against £91,706 in the previous year. This was due partly to the development of Indian traffic, and partly the result of extra traffic occasioned by the Afghan Boundary Commission and the Burmah war. The total receipts, however, amounted to £101,928 against £93,693 in the year 1884-85, there having been a falling off of over £1,000, in the miscellaneous receipts. In this connection, the following paragraph culled from the report will not be uninteresting.—"Contrary to recent experience the growth was entirely due to the development, exceptional or otherwise, of Indian traffic, that with the Far East remaining stationary. It will be remembered that for several preceding years the exact opposite was the case, the Far East receipts increasing rapidly, while the Indian receipts rather receded." The ordinary expenditure debited for 1885-86 was £85,638, or a little more than that of the previous year. Although, as seen from the foregoing statement, there was an advance of £9,000 on the figure for 1884-45, there was a net loss of £60,000. This was due in a great measure to the severe

winter in Persia; the destruction of lines on that section: the renewal of the cable between Bushire and Jaskh, and the unlooked-for accident—the very first of its kind in the annals of the Department—to the cable steamer which necessitated the chartering of another vessel for repairing the cable. Apart from these unavoidable circumstances the expenditure under almost every other ordinary head has been increased, which contributes heavily to the cost of maintenance and working of the line, and we are glad to learn that the subject of retrenchment in that direction is engaging the serious attention of the Government of India.

Considering how very large the capital outlay of the undertaking has been, it is almost hopeless to expect an adequate return; at the same time the fact of the Department having rendered yeoman service to the State should not preclude the idea of effecting such reductions as could be safely carried out without militating against its efficiency. The duration of total interruptions to traffic was nearly fifty per cent. longer than in the previous year, but it is admitted that the laying of the new cable between Jaskh and Bushire will minimize the difficulties in keeping the communication open. The duration of partial interruptions was less by sixteen per cent. The percentage of errors was higher and the speed of transmission was less than in 1884-85. These are partially attributed to pressure of traffic during interruptions in the Red Sea route. The complaints from the public also were more numerous, but a considerable number had reference to the defects outside the departmental system. In regard to the distribution of custom over the lines we find that the paid messages in the year under review numbered 113,546, of which 109,412 of 1,330,030 words were commercial and private, 3,943 of 247,351 words comprised Government messages, and 191 of 91,621 words went to the London *Times*. This last is an instance of journalistic enterprise which could not find a match in any part of the world. The report under review has a mournful interest attached to it inasmuch as it is the last we shall have had from the pen of that grand soldier Sir John Bateman Champain, Colonel R.E., whose early death all India has had occasion to mourn only the other day.

COMPOUND LOCOMOTIVES AND JACKETTED CYLINDERS.

At the meeting of the Institution of Mechanical Engineers, held in London in August last, two very important papers were read; the one giving an account of certain experiments on the steam jacketting and compounding of locomotive cylinders in Russia, by Mr. Alexander Barodin; and the other on the working of compound locomotives in India, by Mr. Charles Sandiford. The two papers were discussed together and several important facts and opinions were elicited. On one point, however, there seemed to be the utmost difference of opinion, and that was as to the utility or otherwise of the steam jacket. Some speakers took it for granted that the value of the steam jacket was unquestionable; while others with equal certainty assumed that no one any longer believed that its advantages outweighed its extra cost.

The Council of the Institution felt so strongly the desirableness of settling for once and all this important question, that they have since decided to appoint a research committee to investigate the whole question. This committee will receive a grant from the funds of the Institution, sufficient to defray the cost of any experiments it may recommend to be made. It will comprise some of the first Mechanical Engineers of the day, and was to have commenced its operations in February. There can be no question whatever, but that the subject is one of great importance, and the report of the committee will be looked forward to, by Engineers of all countries, with the greatest interest.

With regard to the other question which was discussed at the same time, namely, compounding of locomotives; this is also a subject of great interest. The plans shewn by Mr. Sandiford, especially that of his engine with 2 cylinders, were specially approved. Compound locomotives are slowly making headway in England. Mr. F. W. Webb, Locomotive Superintendent of the London and North-Western Railway, has made a considerable number according to his particular type, and, as far as information has been published, it would appear that they are doing remarkably well.

Mr. Worsdell, formerly Locomotive Superintendent of the Great Eastern Railway, but now of the North-Eastern Railway, has also built several compound engines with 2 cylinders each, which resemble very closely those of Mr. Sandiford. The pressure at which he works is 130 to 170lbs. per square inch, and the saving appears to be about 4½lbs. of coal per mile, as compared with other engines. Mr. Worsdell has built both goods and express passenger engines on the compound principle, and one of the latter is now running the Scotch express between Newcastle and York.

THE BOILERS ACT IN THE MOFUSSIL.

The intended extension of the Presidency Boilers Act to the Mofussil is beginning to cause dissatisfaction in some quarters.

The mining interests are strong in their protestation against the rules, the appointment of an Inspector and the fees payable thereunder, and some of them consider the extension of the Act a mistake and likely to lead to disastrous results. In so far as the European Companies are concerned they nearly, if not all, have for many years past at a high cost maintained skilled European establishments for the special object of keeping boilers and prime movers in a safe and efficient condition, and as a convincing proof that that condition has been ensured they proudly point to the fact of there not having been a single accident in their collieries since the commencement of the mining industry in this country. They further argue that the industry is already overburdened with taxes, that the mining operations are gradually becoming more expensive, and that any further imposition in the shape of fees, &c., under the provisions of the proposed law, is likely to retard the progress of the industry and check the spirit of enter-

prise in this direction. The Penal Code, it is suggested, is sufficiently stringent and wide in its application to meet the requirements of any case of neglect or accident, and it would suffice for the demands of the intended measure were the various Companies, whose boilers and engines are under competent control and careful supervision, required to submit monthly a tabulated statement exhibitive of the condition of steam vessels and prime movers, &c., working at each concern, with a certificate from their respective Engineers, who would be looked to as the responsible persons in case of an accident to life or property.

They further deprecate the high fees and travelling expenses leviable under the Presidency Act and think that there is room for a considerable reduction should the operation of the law be eventually extended to their subdivision. Such fees, &c., should it is contended only be realised from concerns not having, and being unable to afford the entertainment of, European or duly qualified and competent agency for the purposes of the Act.

We commend the above to the careful consideration of Government and trust that when deciding upon the opportuneness of the application of the Boilers Act to the Mofussil, they will not forget to attach to the observations and arguments arrayed by the interests affected, the importance they merit. It must, however, be stated as a fact that the Boilers Act at Home, unlike those in force in the Presidency centres of this country, does *not* make Inspection compulsory, and it is this very circumstance that makes the hardship felt more keenly by those interested in the mining industry.

We would, moreover, point out that the rules framed under the Bengal Council Act III of 1879, will bear considerable amendment and that the fees therein provided are excessive. There should be only *one* Inspection, if at all—a thorough examination once a year and every precaution taken by Legislature that such Inspection does not cause any annoyance or entail unnecessary hardship on the owners or their agents and representatives. The season for Inspection should be fixed as between November and June —never in the rains, as it would act ruinously on the proprietary and the property.

BRITISH HEMATITE IRON MINES.

The hematite iron mining dstricts of the old country seem likely to play a still more prominent part in the future than they have even done in the past. The gradual supersession of iron by steel has steadily increased the demand for the purer brands of pig-iron. made from hematite ores. Formerly the North-Western part of England had this trade almost entirely to itself. But certain foreign localities similarly endowed by nature, especially the district lying to the South and West of the river Nervion in the province of Viscaya in Spain, have for long entered into serious competition with it.

This competition has latterly grown more and more severe; until last year at least half the hematite pig-iron made in Great Britain was derived from imported ores. But the growth of competition from abroad was not the only difficulty to be contended with. The gradual falling-off of the demand for finished steel, which has been going on just when it was of the greatest importance in view of the increased power of supply that it should be kept up, was a severe trial and naturally resulted in a continuous fall of prices. The mine-owners finding at last that they could not raise ore at a profit, set themselves vigorously to work to get royalties, railway rates, and workman's wages reduced. They found, however, that their efforts in these directions were attended with very little success, and, consequently, three or four months since the mines of Cumberland and North Lancashire were being closed in all directions, and the miners discharged. Indeed it seemed as if Spanish ore was likely to supersede all others. But things have entirely changed of late. The depression of trade has passed away in the United States of America, and British trade is decidedly better. Whether the revival is a sentimental one, depending on the feelings and ideas of the general public; or a practical one, depending on their actual wants and requirements need not here be discussed. There can be no question that an actual revival, at all events so far as regards steel and the materials of which it is made, has fairly commenced. Hematite pig-iron is three or four shillings per ton more than it was at the lowest, and hematite ore has proportionately advanced in value. No one is feeling the benefit more than the British hematite mine owners. In the short space of three or four months the aspect of things has entirely changed with them. The shares of their several companies have increased in value, sometimes as much as 400 or 500 per cent, with a corresponding activity in the industry.

It seems curious that hematite ore should be exported at all from Great Britain seeing that so much has to be imported. It is, however, a fact that large exportations are going on. Last year nearly 200,000 tons were sent from the port of Barrow to the United States of America. The ore sent was one of the richest ores produced, and was probably destined for use in Siemen's furnaces. To understand this apparent anomaly it must be remembered that Cumberland and Lancashire ores differ from those of Spain, Elba, and Algiers in that they are anhydrous, or red hematites, whereas the latter are hydrated or brown hematites. This means more iron in proportion to total weight and less water. Considering the distance to be travelled by ores destined for use in the United States, not only by sea, but also by land afterwards, it is obvious that there is a great advantage to the buyers, in securing those ores which contain the most metallic iron, and the least water and other substances. This then accounts for the keen American steel makers buying so largely the very purest and richest ore which Europe produces even though they have to pay a very high price for it.

Notes from China.—A loan for five million marks has been concluded by H. E. the Viceroy of Chihli with some German financiers at 5½ per cent. per annum interest.

The Governor of Kweichow has memorialized the Emperor of China for permission to open the mines of the province with the aid of foreign machinery.

The Kaiping Extension Railway, we hear, has made rapid progress in spite of snow, fog, and other obstructions. Only nine miles of the new section remain to be finished, and before the end of March it is expected the line will be brought close to Lu-tai, probably before the rails are on the ground.

Notes and Comments.

CEYLON RAILWAYS EXTENSION.—Notwithstanding the explicit declaration of the Secretary of State that a line similar to that at Darjeeling is inadequate for the work it will be required to perform in the Colony, we learn that Mr. F. Prestage recently went over the trace of the proposed extension of the railway to Haputale, with a view to ascertaining personally whether it will not be possible to construct a 2½ feet gauge line to that district.

THE MHOW WATER WORKS.—It is confidently expected that the works in connection with the Mhow Water Supply scheme will be completed by the end of May next. The dimensions of the bund are 3,570 feet long, 240 feet wide at bottom, and 46 feet high—requiring 300,000 c-feet of stone pitching. The waste weir involves 2,500,000 c-feet of hard rock cutting. Concrete is the material employed for the reservoir walls.

THE MAYO PRIZES FOR ART WORKMANSHIP.—The Sir J. J. School of Art, Bombay, offers a prize of Rs. 180 and a Silver Medal for the best specimen of Lacquered work and a prize of Rs. 180 and a Silver Medal for the best specimen of Printing on Cotton or Silk. These prizes are open to all artisans throughout India. The prize works remain the property of the competitors. The objects for competition must be delivered by the 31st of December 1887.

THE TANSA WATER WORKS.—The first consignment from Glasgow of 48-inch mains for the Tansa Water Works, has just arrived in Bombay. These large mains are each 12½ feet long, and weigh 4 tons. To give some idea of the magnitude of the Tansa pipe contract, it is only necessary to add that it will require from 50 to 60 large steam-ships to transport them from Glasgow to Bombay. This, we believe, is the largest pipe contract which has been undertaken by one firm in India.

HYDERABAD DIAMONDS.—The Australian nugget is known to increase in size as its reputation travels, and so with the Golconda Diamond. It has been correctly observed as regards the Hyderabad (Deccan) Company's recent "finds" that "to the ordinary unsophisticated humdrum mind, it seems quite certain that the Company must succeed in finding diamonds; but whether they will continue to do so sufficiently to render the speculation a paying one, is a mighty nnknown."

MR. H. M. MATHEWS, C.I.E., M.I.C.E.—The direct London boat from Rangoon takes away from Burma the late Manager and Engineer-in-Chief Burma State Railways. Mr. Mathews retires after 20 years of unrivalled good service, during which time he became loved and esteemed by all who came in contact with him. Mr. Mathews leaves many friends and well-wishers behind and at a time when the Province can ill-spare him; but his health has been very bad for some time, and he is obliged to retire.

OPENING OF THE GUNDUCK BRIDGE.—The bridge over the Gunduck River, consisting of eight spans of 250 feet each, connecting the Tirhoot State Railway, with the Bengal and North-Western Railway, was declared open on the 30th March afternoon by the Viceroy at Sir Steuart Bayley's request, in the presence of a large number of visitors from the surrounding district. After the ceremony, the company crossed the bridge, and proceeded to the west bank of the river, to a *shamianah* where luncheon was served.

A RAILWAY TO ORISSA.—While conceding that a line connecting Puri with the Bengal-Nagpur Railway is desirable on many counts, we are disposed to think that a line from Raipur to Vizagapatam is preferable as an outlet for the Central Provinces. The latter route has been actually surveyed, and financial considerations alone precluded the Government from commencing the work a couple years back. Its advantages are so palpable, that the concession of constructing it is now being sought by speculators at Home.

THE AGRICULTURAL DEPARTMENT, MADRAS.—It is worthy of note that a Company has been formed in Madras for the purpose of reeling cocoons of the indigenous Tusser silk-worm, and that active operations have actually commenced. We are glad to learn that the re-opening of the subject of resuscitating the Saidapet Farm, which has been a white elephant on the hands of the Madras Government ever since its birth, has been declined by the local Government "after a full consideration of all the arguments *pro and con*."

P. W. D. ADMINISTRATIVE CHANGES.—Major G. F. L. Marshall, R.E. is leaving the post of Under-Secretary to the Government of India, P. W. D., which he has held for many years, to take up the appointment of Superintending Engineer at Mount Abu, in succession to Colonel J. P. Steel, R.E., who goes to the Punjab as Chief Engineer in place of Colonel Æneas Perkins, C.B., R.E. Mr. R. B. Buckley, from Bengal, succeeds Major Marshall. We understand that great indignation is felt in the Punjab at Colonel Steel's accession to the Chief Engineership.

A PRACTICAL NOTE.—The disadvantages of Portland Cement for the exterior plastering of walls and terraces is shown by the fact that about three and a half years ago it was used for replastering the Madras Kirk dome—inside and outside—and it is now found that the use of the material on the exterior of the dome was a mistake, as the water percolated through and kept the interior surface damp during the rainy season. The P. W. D. have therefore taken the dome of the Kirk in hand again, and have removed the cement from the exterior of the dome, and have replastered it with chunam.

ADVANCE CABUL!—Mr. T. S. Pyne, M. I. M. E., representative of Messrs. Walsh, Lovett & Co., left Jamrud for Cabul under an escort of the Amir's cavalry on the 24th ultimo. The object of Mr. Pyne's engagement is for the erection of new work-shops and the fitting of them with the latest machinery with a view to render the Afghan ruler independent of extraneous sources in an important respect. We understand that ironstone, coal, and other minerals are found beyond our frontier in abundance, and it is in contemplation to work them. Mr. Pyne takes two Chinese miners with him and several Indian workmen.

BENGAL-NAGPUR RAILWAY COMPANY, LIMITED.—This Company proposes to enter into a contract with the Secretary of State in Council of India, in the form scheduled to an agreement of 22nd February between the said Secretary of State and Robert Miller; and under the same, to construct, maintain, and work the railways and works from time to time constituting the "undertaking" defined in such contract. The company was registered on the 23rd idem, with a capital of £3,000,000, in £20 shares. The subscribers include General C. H. Dickens, and Colonel F. S. Stanton, R. E., who are also Directors. The number of directors is not to be less than five, nor

more than nine; qualification, fifty shares, or equivalent stock; remuneration, £2,000 per annum.

DEHRA DUN RAILWAY.—In our first issue we noticed that the Government of the North-Western Provinces and Oudh had undertaken to check the survey made in 1884 by the promoters of the proposed railway from Hardwar to Dehra and Rajpur, and also to survey other possible routes between those places. We now learn that Mr. E. L. Hunt, the Executive Engineer in charge of the Survey, and who has been gazetted for furlough from 9th instant, has finished his field work, and that his report and estimates of the various alternative lines examined will be submitted to Goverment before that date. We hear that no better line has been found than that selected by the promoters. Considering Mr. Hunt's standing and experience in the Railway Branch of the P. W. D., the promoters of the scheme are to be congratulated on the result of his investigations.

THE RAMASWARAM CANAL.—We find that the project for a channel or passage through the barrier which partially connects the mainland of India with the island of Ceylon is still within the domain of speculation. Lately the Madras Government having had submitted to them through the Secretary of State proposals on behalf of a Company to construct a Canal through the island of Ramaswaram, they have replied that the rate laid down for the levy of the canal fees is considered by the Chamber of Commerce, who have had the opinions of a number of masters of vessels, prohibitive, and that these fees should be reduced and regulated in a manner somewhat similar to the Suez Canal fees. But, despite all this, we are disposed to think it doubtful whether steamers would take this inner passage, and as regards the coasting trade the existing Paumben Pass would seem to meet all the requirements of the native craft engaged in the same.

BUDGET NOTES.—The annual loan for Public Works will amount to 5½ crores, and will be raised in India. No Public Works Sterling Loan will be raised this year. A comparison with past accounts of the assignments now made for Provincial expenditure shews that the retrenchment of Provincial expenditure is mostly in the case of original public works. Since 1877, when the Famine Insurance scheme was introduced, 5,554 miles of railway have been completed or put into active construction, and over six millions has been contributed towards the prosecution of these railways from the Famine Insurance Grant, which is now suspended. The net loss to the State on State and Guaranteed Railways in the Revised Estimates of 1886-87 is £1,177,900 and in Estimates of 1887-88, £1,383,700, the increased net loss being mainly due to heavy renewals required on the former Sind Panjab, and Delhi Railway, and to the interest due on the large amount of Capital representing unopened lines.

IRRIGATION OF ALKALI LANDS.—Mr. William Willcocks—so well-known in the Academic history of Rurkee—in a recent Paper on "Irrigation in Lower Egypt," read before the Institution of Civil Engineers in London, made reference to the evils of "Salt-efflorescence," from excessive flooding from the Nile. He particularises a belt of land formerly very fertile now barren owing to salt efflorescence and lack of drainage. The same troubles that are so well-known in India are threatening irrigation in the southern part of the State of California where the *Reh* plague of India has already made its appearance. It is thus accounted for by an American Scientist:—Continuous irrigation has raised the water table, so that only from half to one-third the quantity of water is now needed: but there is danger of a superabundance of water forcing roots near the surface, while the Alkali will also be brought near the surface and cause various evils to health, and would ultimately render the land unfit for cultivation unless relieved of the accumulation of alkali. The remedy is "under drainage."

THE SUSPICIOUS CONDITION OF THE COLOMBO BREAKWATER.—Along the inside face of the Colombo breakwater the concrete blocks run alternately 12 feet × 12 feet × 6 feet, surface measurement. For a distance of 37 blocks, say rather more than 400 feet in length, this inner portion of the Colombo breakwater has settled to such an extent that not only have the smaller blocks come apart from the great breadth of the main erection, but the 18 alternate large blocks are broken right across, the fracture in each of them meeting at either end the crevices made by the parting of the adjacent 6 feet blocks from the main building. Thus, there is formed, as it were, a continuous parting or crevice 400 feet in length, a long slice, so to say, that has settled to such an extent as to cause its falling away from its original position. Some of the blocks have evidently tilted up, the one side having visibly been raised, whilst the opposite one has sunk. This, we have been told, is the settlement which must inevitably be expected in works of this nature.

THE ROORKEE FOUNDRY AND ENGINEERING COMPANY, LIMITED.—This Company has been formed to take over and carry on the valuable and extensive Foundry and Engineering Works at Roorkee, in the North-West Provinces of India, which for many years past have been in successful operation under the Public Works Department of the Government of India, and have been secured by the present Vendors under contract with the Government of India, in pursuance of its policy of withdrawal from competition with private enterprise. The Share Capital has been fixed at £80,000, and the Debenture Capital at £50,000. The Board of Directors includes, General Alexander Fraser, late Secretary to the Government of India, P. W, D.; and Mr. Henry Prince, formerly Engineer-in-Chief, Indian State Railways. Mr. W. B. Macrone, late Executive Engineer Indian P. W. D., has been appointed Secretary. We understand that Mr. Angus Campbell will be retained as Superintendent of the "Works."

THE CHINESE AS COLONISTS.—The Australians urge that there is no moral or international consideration binding (them) to throw open their ports and lands to a foreign people, for whose presence they have no wish. The first rule of national existence is self-preservation, and there can be no doubt that with a large influx of Asiatics the European population would suffer, and the European character of the country would be destroyed. China is populous and Australia is thinly inhabited; and a tide of emigration, if it were allowed to set in, might swamp the colonies with a most undesirable element. It was no local jealousy but broad grounds of expediency and policy that led to the imposition of the poll-tax—wherein lies the only difference between the Chinese and Europeans. It is simply a measure of self-preservation, the terms of which are thoroughly well-known. The best thing, therefore, that the Marquis Tseng can do is to draft his would-be emigrants into the inland provinces of the "flowery land," and keep them under his own jurisdiction.

Current News.

THE first cotton factory in the Panjab was started at Amritsar on the 21st March.

THE Duchess of Connaught opened the Chuppar Bridge, S. P. R., on the 27th March.

THE Belgaum Branch of the Southern Mahratta Railway was opened for traffic on the 21st March.

MR. ROBINSON, the Acting Agent of the Madras Railway has been permanently appointed as "Agent."

THE Archæological Department has been definitely transferred from the Home Department to that of the Revenue.

MR. T. ANDERSON, Chief Engineer, H. M.'s Indian Marine, is appointed to be Inspector of Machinery, Kidderpore Dockyard.

THE Government Flour Mill at Cawnpore gives employment to 40 natives and two Europeans, and issues 520,500 lbs. of wheat every month.

THE Commander-in-Chief has just visited the Sukkur Bridge-works, which are progressing steadily, and also the Defence works in the neighbourhood

A CONTEMPORARY learns by telegraph from England that Mr. W. H. Jobbins has been appointed Superintendent of the Calcutta School of Art.

LADY AITCHISON laid the foundation-stone of a Memorial Church at Mardan, to be erected to the memory of deceased officers of the Queen's Own Corps of Guides.

A CONTEMPORARY hears that two Honorary Assistant Superintendents in the Telegraph Department are to be promoted to the permanent grade of Assistant Superintendent.

THE success of the Bengal-Nagpur Railway scheme, which was subscribed three times over, has given an impulse to another project for making a railway from Benares southwards.

LIEUTENANT-COLONEL PITCHER, Deputy Director of Agriculture and Commerce in these Provinces, acts as Director of the Department when Mr. D. M. Smeaton goes to Burma.

GREAT changes will take place at the Goalundo end of the Eastern Bengal State Railway line in anticipation of the rainy season. So far as the main line is concerned, Rajbari will be the last station.

IT has been definitely settled that the Viceroy shall be asked to open the Ganges Bridge towards the close of the year, probably in November; and work in connection with the Bridge, is being vigorously pushed on.

IN 1885-86, the gross receipts of the Madras Salt Department increased to Rs. 1,44,82,272, or by nearly seven lakhs, while the charges were reduced by nearly four lakhs, making an increase in the net receipts of more than ten lakhs.

THE Secretary of State has been requested by telegram to defer action in the matter of the abolition of the gunpowder factory till the Madras Government's despatch on the subject has received the consideration of his Lordship in Council.

IT is probable that Sir Charles Elliott will succeed Sir Theodore Hope as member of Council for the Public Works Department, and that an English financier will be brought out to take the place of Sir Auckland Colvin as Finance Minister.

THE Town Council of Bombay have unanimously recommended the Corporation to sanction the special grant of Rs. 80,000 in aid of the Victoria Technical Institution under the head of educational grants as suggested by the Director of Public Instruction.

THE *Deccan Times* believes that it has been settled that Sardar Dilar Jung is to be sent to England by his Highness' Government to confer with the Directors of the State Railway on certain important questions which cannot be disposed off from Hyderabad.

A CAWNPORE correspondent writes to a Calcutta paper under date the 18th inst. :—The increase of goods traffic *viâ* B. B. and C. I Railway, between Cawnpore and Agra, running parallel to the E. I. R., is watched with alarm by the authorities of the latter Railway Company.

THE Government of India, having before them the special report of Dr. Ribbentrop, head of the Forest Department, have decided to allow the Bombay-Burma Trading Company to continue their leases of such forests as they were working in Upper Burma during Thebaw's time.

THE question of increasing the Engineering Staff of the South Indian Railway having been recently discussed, the Supreme Government have, upon the recommendation of the Board of Directors in England, sanctioned the entertainment of three Assistant Engineers at once, temporarily.

THE Board of Directors of the East Indian Railway Company have called upon the Railway authorities in this country to explain why the expenses of the Store Department of the Company, instead of decreasing, have greatly increased, consequent on the amalgamation of the District Stores with the General Stores.

A STEAM tramway is to be constructed connecting Suri, the capital of the Birbhum District, with Ahmadpur, a station on the East Indian Railway. The proposed line will be laid on the side of an existing district road, 13 miles in length, but a few diversions are necessary, owing to the steepness of the present gradients.

MR H. B. BLAKE, for a long time past Deputy Superintendent of the Lahore Jail, where, among other things, prisoners learn to make carpets, goes at the expiration of his service under Government to Amritsar, there to supervise—for Messrs. Davee Sahai and Chamba Mall, carpet manufacturers—the erection of a new factory on a large scale, and generally to control the weaving operations.

IN the third quarter of last year there was an increase of 165½ miles in the length of railways open throughout India as compared with the corresponding quarter of the previous year, the total number of miles open at the end of September last being 12,292½. There was also an increase of 370 per cent. in the train mileage, and there was a decrease of no less than 29 in the total number of accidents.

MR. PALMER, Chief Engineer and Secretary to Government, Nizam's P. W. D., is at present at Madras conferring with Colonel Pennycuick, R. E., Chief Engineer for Irrigation, as to the various systems of irrigation in that Presidency, and which is best calculated to suit the conditions of the Telingana country, and the proposals now on foot to secure its reclamation and insure its cultivation.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

SHIKARPUR MUNICIPAL SECRETARYSHIP.

SIR,—By order of the Managing Committee I have the honour to request you will be good enough to give publicity to the following in the columns of your widely circulated paper :—

Although the Shikarpur Municipal Secretaryship was advertised for a European or a Eurasian, the Municipality have since deemed it expedient and economical to appoint a Native and they have accordingly conferred the appointment of the Secretary on an experienced Native Engineer possessing high moral character.

SHIKARPUR; *March* 19. R. G. OAK,
Secretary, Municipality.

THE MEER ALLUM LAKE DAM.

SIR,—I was particularly pleased with the Dam at the Meer Allum Lake described in your issue of the 5th February last. To make it in a straight line of arches is evidently the right thing. But I do not see any special advantage in *curving* the line of arches. If it was not cut up into smaller ones, which break the continuity of the line of thrust, making it circular (convex) there would be some sense in it—though that is not novel. It has always struck me that the modern plan of putting a, straight dam across a valley is altogether wrong as it requires enormous strength to avoid being swept away.

MIDDLESBROUGH, YORKSHIRE; *March* 1. J. H.

MADRAS DRAINAGE WORKS.

SIR,—I see in your issue of the 12th March a paragraph regarding some remarks of Colonel Pennycuick, R. E., on the Madras Drainage Scheme. The paragraph is so worded that some not acquainted with the facts might suppose that that officer had volunteered the expression of opinion stated therein, which considering Mr. Jones' standing in the Profession would be something very like an impertinence on his part.

The facts are that the criticisms to which Colonel Pennycuick alludes were freely indulged in by some of the Commissioners, so that the Chairman, in order to satisfy them, applied to the Madras Government to appoint a Committee of Engineers to report upon the Drainage Works. The Government considered that a report from a single officer of experience would be more satisfactory than one from a Committee and directed Colonel Pennycuick to undertake the duty. The expression of opinion which you have quoted is merely the substance of the concluding paragraph of his report.

I mention these facts in case you think it worth while to insert them to correct any mistaken impression which your notice might create.

MADRAS CLUB; *March* 18. R E.

GARSON'S PATENT SUSPENSION BRIDGE.

SIR,—I see that my remarks on this Bridge are not thrown away, for at least one Engineer, besides the designer, has fallen into the errors of construction that have discredited pin connexions, which, if properly designed, are quite as good as rivetted joints.

I will reply *seriatim* to your correspondent "X."

Firstly.—Anyone acquainted with even elementary statics, should know that the strains in a frame triangulated throughout, are not the same as in one hinged at the centre.

Does "X" mean to say, that the strains in a spandril braced arch are the same, whether hinged at crown or not?—for this is virtually the assertion he makes, if for tension, as in this case, you read compression.

My remark about the loose link, implied that it might be put in for appearance sake without altering the stresses, *provided* the holes were made so oval that it never came into play with any

deflection of the bridge. I do not suppose this is the case, and therefore the designers of the bridge are quite ignorant of what the strains will be under a rolling load.

The solution is tedious, but if it would be useful to your readers, I might give it some day, on being furnished with full particulars of the loading this bridge is supposed to take.

Secondly.—Regarding strain on post.

There is a strain of 7·175 tons in A B the resultant of the last two links, as shown in original diagram, which is equilibrated by the strains in post A C and back stay A D—*fig.* 1.

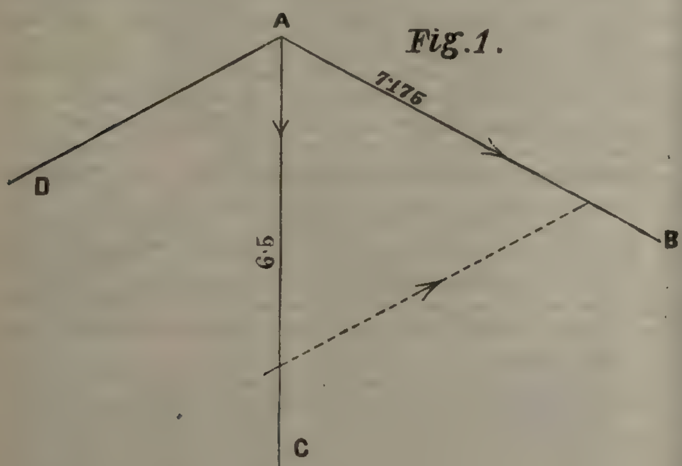


Fig.1.

Marking off then 7·175 tons on A B to $\frac{1}{4}$ inch scale, and drawing the dotted line parallel to A D, we have a simple triangle of forces, giving 6·5 on post.

Will "X" point out in detail, the error in this treatment?

Thirdly.—It is evident from the way he reckons up the bearing area of a pin, that "X" has no idea of the proper construction of a pin joint.

The bearing area is simply the diameter × width, on which point consult any book on construction. The critical point in a pin joint, is never the shear, but the bearing area and bending stress on pin, and with your permission I will go somewhat at length into this subject, as it is generally neglected, and pin joints are abused, simply because no attention is paid to the most obvious details of design.

The conditions then of the best practice are,—that the pressure on bearing area of pin or link should not exceed 5 tons per square inch, and that the bending stresses on extreme fibres of pin, reckoning loads as applied at the centre of the links, shall not exceed 5 tons per square inch.

If these conditions are satisfied, it will be found that the shearing area is always vastly in excess of that indicated by the consideration of shear alone.

Your Correspondent's remark about the pin being steel is beside the point, for the eye of the bar, which is iron, has to be considered quite as much. Moreover, the figures I have given above *are* for steel.

I showed before, *pace* "X," that the bearing stress was excessive; we will now proceed to examine the bending stresses in the pins, and here we find another nicety of construction of which neither "X" nor the designer have ever dreamed—*viz.*, the packing of the bars on the pin.

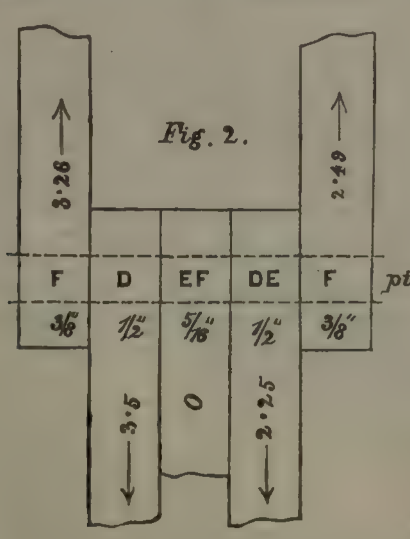


Fig. 2.

The drawings do not shew how the bars are packed, but the arrangement shewn in *fig* 2 is probably as good as any. This is a diagram of the packing of bars at the first top joint of the original drawing, and the same letters of reference are used. Only the forces in the plane of bars F are considered, to simplify the case.

It will be seen at a glance that it is impossible so to pack this joint as to have an equal strain on both bars F; with the given strains on D and D E, they will be 3·26 and 2·49 tons instead of being 2·87 in each.

Taking therefore the link that has to carry 3·26 tons, we have $1\frac{1}{8}'' \times \frac{3}{8}''$ for bearing area, which divided into 3·26 gives a stress of 7·7 tons per square inch, even worse than it appeared on a casual inspection.

For bending moment on pin, which is best found by a graphic construction, we have 1·4 inch tons, and the modulus of a $1\frac{1}{8}''$ pin is 0·1398 inch units, which divided into the bending moment gives 10 tons as the stress on extreme fibres, about double what it ought to be.

It will be observed that I have throughout assumed the strains given in the diagram, but as already indicated, this is not correct with a centre link, and the full load is only shewn on 4 centre panels.

If the Public Works Department of Bengal are using these Bridges, they would do well to get some competent Bridge Engineer to check the whole design, not forgetting wind stresses, supplying him with the working drawing of Bridge and load it is to carry.

It would pay the makers themselves to do this, as the difference in cost to make the Bridges lasting is very trifling. Such details might have passed muster 50 years ago, when little was known on the subject of joints, but they are inexcusable at the present time. When those little matters have been attended to, the makers may perhaps claim that "it fulfils the most stringent conditions of engineering efficiency, &c." At present the structure is not absolutely dangerous, but will soon wear out.

I will conclude with a table of the "modulus" of pins in inch units, which your readers will find handy. This quantity multiplied by the permissible strain in tons per square inch must equal the maximum bending moment in inch tons. F. E. R.

Modulus of Pins, inch units × by strain = M of resistance in inch tons.

Dia.	0	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
1	0·0982	0·1398	0·1918	0·2552	0·3314	0·4214	0·5263	0·6473
2	0·7856	0·9423	1·1184	1·3155	1·5344	1·7762	2·0422	2·3336
3	2·6514	2·9968	3.3711	3·7751	4·2103	4·6777	5·1785	5·7138
4	6·2848	...	...	...	...	...	...	...

THE BATTLE OF THE MAIN.

SIR,—Allow me to correct an error in Part II of your interesting description of the "Battle of the Main." Quoting from the Honourable Mr. Reynolds' remarks you say:

"But they (the Commissioners) did not take into account the possibility of the test proving fatal to the main itself, and if such a calamity should happen the loss to the Corporation could only be estimated by lakhs of rupees."

For your information we may mention that the Commissioners employed our firm to superintend the manufacture of these pipes and carry out the necessary tests, &c., and under the immediate superintendence of our Mr. Edward Jackson, M. Inst. C. E., each and every pipe in this main was carefully tested by hydrostatic pressure equal to a column of water *200 feet high*, and whilst subject to this pressure, was struck by a 5lbs hammer from end to end.

We therefore consider the "fearful calamity" suggested is not within the bounds of possibility, so far as the pipes themselves are concerned.

ROBERT A. OLDHAM, M. INST. C. E.
(OLDHAM BROTHERS.)

Notes and Queries.

A. A. K. (Bellary), Wants to know where he can learn full particulars, and obtain appliances, for *Electro-plating and Gilding* on a small scale.

Literary Notices.

JOURNAL OF THE UNITED SERVICE INSTITUTION OF INDIA.
February 1887.

THIS number contains some useful "Hints on Military Landscape Sketching," by Major L. F. Brown, R. E. The author utilises the fact that the gradual training of the eye into proper ideas of proportion, makes the habit of correct drawing instinctive. His system is an extension of the principle of the plane table combined with free-hand drawing for Landscape Sketching. It is certainly a better means of conveying a *correct* idea of a view than the artistic modes usually adopted—even preferable to the camera.

General Articles.

SIR BRADFORD LESLIE.

SIR BRADFORD LESLIE'S departure from India though nominally for eighteen months is likely, we believe, to prove for good. The Government have lately conferred upon him some mark of appreciation of the good work he has done in the country, and as the exponent of the Profession of which he is an ornament, we have been induced to produce the subjoined Memoir and annexed Portrait as a parting tribute to the designer of the two Hooghly Bridges, which rank among the greatest achievements of Indian Engineering.

Mr. Bradford Leslie was apprenticed in 1848 to the celebrated English Engineer. Mr. Isambard Kingdom Brunel, the son and assistant of the, in his day, equally celebrated Engineer of the Thames tunnel, Sir Marc Isambard Brunel, whose mechanical genius and originality of conception was largely inherited by his son, and his mantle in turn has successfully fallen upon his pupil, Mr. Bradford Leslie. The name of the younger Brunel is associated with such well-known works as the Clifton suspension bridge, the docks at Bristol, Sunderland and Cardiff; the Great Western Railway, and pre-eminently, the great Saltash bridge near Plymouth. At the time of his death in 1859 Mr. Brunel was intimately connected with the design and construction of the *Great Eastern* steamship. After serving for ten years under Mr. I. K. Brunel on the large bridge over the Wye at Chepstow and on the Royal Albert Bridge over the Tamar at Saltash, Cornwall, and on many other important railway and dock works, Mr. Leslie was appointed, in 1858, to the charge of the large bridges and viaducts on the Eastern Bengal Railway, including the bridges over the Ichamati and Kumar rivers; he also built the bridges over the Circular and New canals, as well as the Sealdah railway station.

After the completion of these works he returned to England and constructed the Ogmore Valley railroad between Porth-Cawl and Nant-y-Meel in Glamorganshire besides other mineral railways.

In 1855 Mr. Leslie was chosen by Mr. Brunel, who was then the Consulting Engineer of the Eastern Bengal State Railway, for the charge of the Goalundo extension of that line. The wisdom of this selection was soon justified by the high degree of inventive and engineering skill which was displayed by Mr. Leslie in the construction of the Gorai bridge. This important work, after occupying three years in construction, was opened by Lord Mayo in 1870; it consists of seven spans of 185 feet, with piers which had to be sunk to a depth of from 80 to 100 feet. These piers were sunk by the help of an engineering contrivance of the highest ingenuity which had been invented by Mr. Leslie, and which was subsequently used for the piers of the Hooghly bridge. The method adopted by Mr. Leslie for the launching of the Gorai girders was substantially the same as that recently made use of for the similar operation on the Hooghly bridge.

On his return to England in 1871 Mr. Leslie accepted the appointment of Consulting Engineer in England to the Oudh and Rohilkund Railway Company. He returned to India in 1872-73 to report for the Secretary of State's information upon the restoration and protection of the bridges of the Sindh-Punjab and Delhi Railway over the Jumna, Beas, and Sutlej rivers, which, though previously giving much trouble, have stood satisfatorily since Mr. Leslie's recommendations were adopted.

The next problem which he set himself to solve, and which, in spite of loudly expressed doubts, he solved satisfactorily, was the bridging of a tidal river subject to great and sudden variations of height and velocity, and requiring free passage at all times for small vessels and at stated periods for large ships. The pontoon bridge over the Hooghly, connecting Howrah with Calcutta which was begun in 1873, was completed in 1874 at a cost of about 18 lakhs. Owing to the absence from the province of the Viceroy and other high officials it was opened to the public without ceremony of any kind but to the great satisfaction of dense crowds of delighted natives who were at the time in the midst of their Durga Pujah holidays. Ballads and hymns were composed by some of the local bards in honour of the occasion of the bridging of the sacred river.

In 1874 Mr. Leslie exchanged with Mr. William Clark the appointment of Consulting Engineer to the Oudh and Rohilkund Railway for that of Engineer to the Calcutta Municipality. This latter appointment he held until, in 1876, he was offered the Agency and Chief Engineership of the East Indian Railway Company. While occupying this important position he set to work to ascertain how the enormous export trade of the Ganges valley might best be conveyed directly to Calcutta, without the expensive and troublesome intervention of carts. The outcome of his investigations is the Hooghly bridge now to be opened which was commenced early in 1884, and has been finished within a period of three years, at a cost of about 49 lakhs. Its successful and rapid completion has been largely due to the valuable experience gained by Mr. Leslie upon his former great works. During the first year the bridge was in the immediate charge of the late Mr. D. Manuell, Chief Resident Engineer, and since his decease Mr. Fritz Graf has been the Resident Engineer in charge of the work. Fifteen months have not yet elapsed since the ironwork of the bridge commenced to arrive from England; the successful launching of the last span was witnessed by Sir Rivers Thompson the Lieutenant-Governor, on the 20th December last. The average time which elapsed from the arrival of each of the three spans in this country until its complete erection was only seven months.

The following few facts will give some idea of the importance and magnitude of the work which is under Mr. Leslie's supervision. The East Indian Railway and the branches worked by it are 1,680 miles in length, of which 1,514 miles are the East Indian Railway proper. This line, which has cost 37 millions sterling is the property of the State, but is worked by a working company, of which Mr. Leslie is the Agent. Of the net profits the Sate receives four-fifths and the Company one-fifth. The State share of these net profits has amounted in a period of six years to about four millions sterling. The work of the railway is carried on by an army of 43,000 persons, of whom 1,000 are Europeans and 600 Eurasians. The employés of the railway form a Volunteer Corps, which is 1,200 strong. The gross revenue which is administered by Mr. Leslie, amounts to Rs. 480 lakhs per annum; this may be compared with the revenue of the Province of Bengal, which is about Rs. 430 lakhs.

After close upon half a century of active service upon engineering work of all degrees of magnitude and importance out of which nearly 30 years have been spent in the service of India, Her Majesty the Empress has been pleased to create Mr. Leslie a Knight Commander of the Indian Empire upon the occasion of the celebration of Her Jubilee in India.

The picture is said to be a "true likeness" of our subject. It has been copied by Babu Anoda Prosad Bagchi, Government School of Arts, from a Photo. taken by Messrs. Bourne and Shepherd, the well-known Photographers of Calcutta.

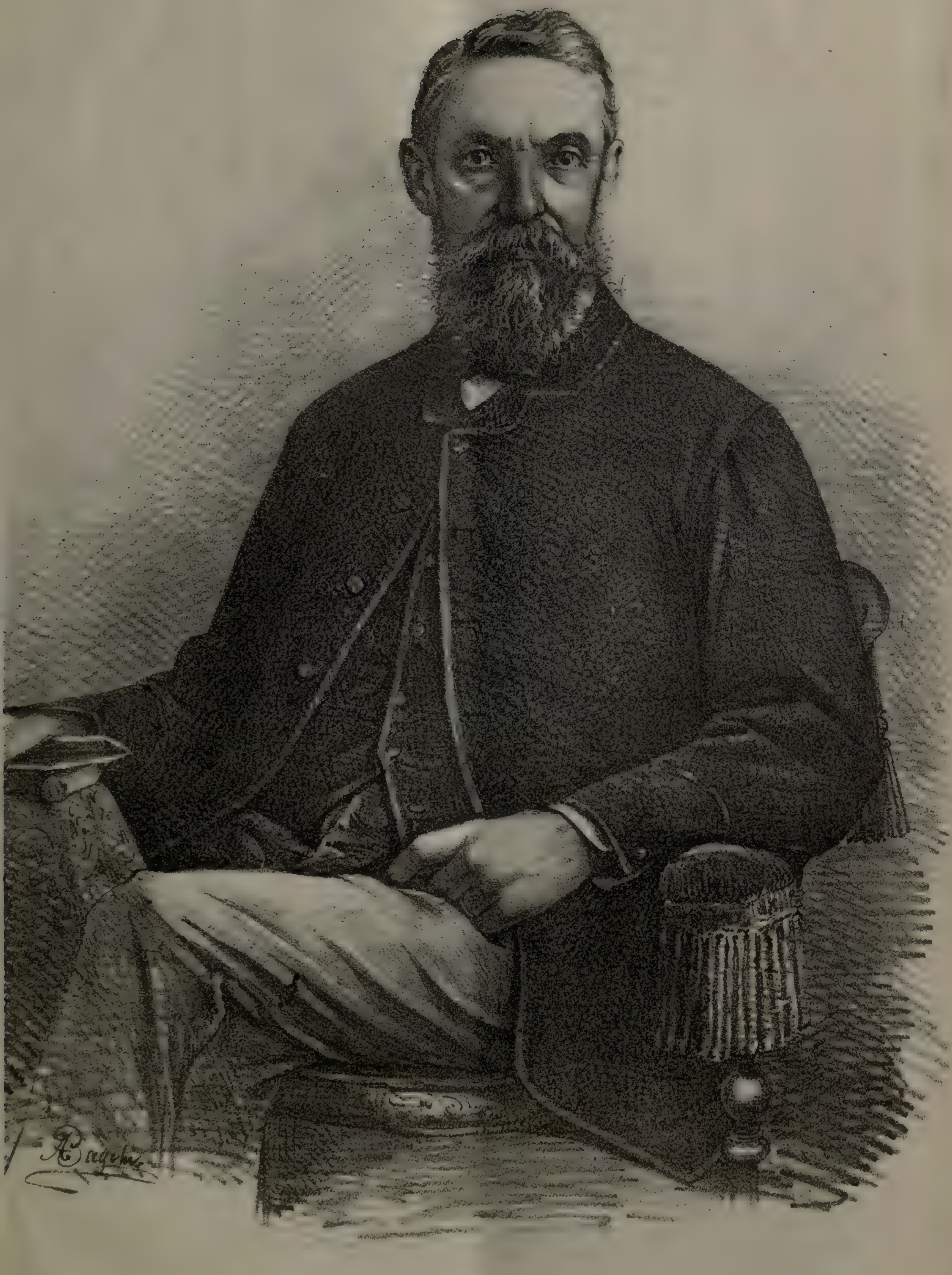
THE PROTECTION OF INVENTIONS AND DESIGNS BILL,—1887.

(Concluded from last issue.)

BY GEO. A. DE PENNING, M. INST. P.A.

SECTION 6, with its sub-sections, should be altogether omitted, for there is no need of reference to experts, whose opinion at the best is questionable. All applications for a patent should be allowed without special enquiry. If an invention is worthless, it will not benefit the inventor or hurt the public, for they will not use it; if the invention is not new, from its being anticipated the patent is void, and the loss is the applicant's, who should make sure by a previous search that no similar invention has been patented.

Section 7 provides that if two or more inventors apply on the same day for leave to file specifications of inventions which appear to be identical or so similar as to be practically identical, both or all may be authorised to file their specifications; but according to sub-section II., if they apply on different days, then the applicant who applied on the first of the different days shall be deemed to have a preferential claim to the order authorising the filing of his specification. But suppose the first applicant obtained his knowledge in fraud of the second or actual inventor, who is to decide the point or right the actual inventor, who by this ruling is refused the order to file his specification?



SIR BRADFORD LESLIE. K. C. I. E.,
M. INST. C. E.

The best and only plan is to record and number all applications as they come in and to grant orders to all the conflicting inventors to file their specifications, letting them refer to the Courts if necessary to settle their contentions.

Section 14. There evidently seems to be an omission in this section, which should clearly state that certified copies of an entry in the register should be deemed evidence in Court. This book should on no consideration be taken out of the Patent Office, as has lately been done in a disputed sugarcane mill case. A sub-section should also provide as in section 13 of the present Act, that certified copies of the applications, specifications and the drawings filed, should be deemed good evidence of the originals.

Section 28. There is apparently some conflict of expression between this section and the intention declared in section 15 of "the statement of objects and reasons." This section of the proposed Bill states that the Indian patent shall cease if the English patent is *revoked*, whereas it is proposed in the statement to abolish the rule of section 20 of the old Act of 1859, which is nearly to the same effect, as it states that an exclusive privilege shall cease if such English patents are *revoked* or *cancelled*. It were as well if it were clearly stated as appears to be the intention that the Indian exclusive privilege will not be affected if the British patent shall be *cancelled* or cease from not being kept up or from non-payment of any of the stamp charges that may have become due or payable. This would protect the Indian patent, which should rightly be considered a distinct right, particularly the assignee thereof, whose purchase would otherwise be jeopardised.

Section 37 binds the actual inventor to institute a suit within two years against an infringing patentee or he is otherwise barred from doing so. So that, a fraudulent patentee has only to wait that time, after which he would be at liberty to infringe the patent or exclusive privilege with impunity. The actual inventor should at any time during the continuance of his patent be allowed to bring infringers to account and have their patents cancelled. What is urgently required is a less costly mode of procedure to effect this purpose or end.

Section 46, with which the Act concludes, is good and much needed; no doubt under its power inventors will have all the required acknowledgments or receipts for applications and specifications as they are filed, in the same form and manner as they are given in England. It is only to be hoped that it will include a proper and printed form of *patent* or "exclusive privilege", as it is called, for India. Some such form of "patent", I may call it, is much needed, while its want disappoints and discourages many. I have even known an inventor to consider the "order" to file his invention more valuable than the certificate that his specification has been filed, for in the former he finds himself noticed, since the Governor-General of India in Council authorises him to file his specification.

PROGRESS IN PATENTS.

"An attempt is being made (says a contemporary) in some quarters to show that the Patents Act 1883 has not answered its purpose, and that it has not reached an entirely fresh class of inventors. It is however, well known to many that the new Act has been a boon to a large number of poor inventors, and that several useful inventions, which would not have been made public, have been protected solely because the reduction of the preliminary expenses –from £25 to £4— has enabled the owners to secure the slight protection a patent gives. In some quarters the rather absurd argument is used that if a patent is worth anything it is worth paying £25 for. But if the inventor has not that sum what is he to do? Seek for a capitalist? That is just the idea of the reformed Patents Act, which demands only £1 as the price of provisional protection for nine months, during which time the owner has an opportunity of securing the requisite capital to make his invention a commercial success. But strange as it may seem, some of the most useful inventions are those devised by men with little money to spend. The lowness of the fees now demanded for a patent in this country has had the effect of attracting a large number of foreign inventors; but whether the foreign or home inventions are worth anything or not, the low preliminary fee is obviously the correct policy. If a patented invention is worth nothing nobody is injured, whereas, if it is useful, no one pays a penny more for it than it is worth, simply because no one uses a patented invention unless he derives some advantage from it. The Patent Office, however, is in a worse plight than ever. The "abstracts" are many years in arrear, and the money that is now wasted in the farcical system of examination would be better expended in clerical labour to bring the indices and abstracts up to date."

BUILDING CONSTRUCTION.

Desirability of resorting to Masonry Arch to avoid the use of large-sized Timber.

THE ARCH plays an important part in building construction. It is recommended both for its strength and durability as also for its beauty and lightness of structure. Besides, the materials required for its construction are of small size, easily procurable and handled with facility by an ordinary person.

Theoretically, with strong abutments and unyielding foundation, an arch, constructed of stone or brick without the use of a cementing material, will stand when completed. When, however, mortar is used as usual, the construction becomes easy, and the whole forms one compact mass. Moreover, the weight on the centre during construction is partly relieved by the sliding force of voussoirs being to a certain extent counteracted by the cohesion of mortar joints.

The advantages of the arch over stone beams common in Hindu architecture,—specimens of which up to 30ft. length used with more or less success, are to be found at Humpy near Bellary with the result that beams of larger spans are mostly failures,—are that the transverse strain on the beams. caused by their own weight and the weight of the superincumbent structure, is converted into pressure and thrust on abutments when the arch is used, and that the thrust which is the only new force is easily provided for by an adequate thickness of abutments. The disadvantages of the arch are that while a small unequal settlement of foundation of pillars supporting a beam (and the principle holds good even with greater force as regards iron girders for bridges resting on piers) often causes no breakage in the beam, it will always produce cracks in the arch and endanger its safety.

It is thus clear that where foundation is unyielding and reliable and abutments can be made of the required strength, the arch is an advantage. When, however, there is a fear, although remote, of the unequal settlement of supports, beams will be an advantage, provided they can bear the transverse strain and test of time. Another advantage in favor of beams, though in buildings it is sometimes not of much consequence, is that they will require smaller height of structure and present no obstacle between the supports.

The above remarks are made to help us in the enquiry as to whether arches can advantageously be introduced in building construction to supply the place of large-sized timber.

Owing to increase of population and facility of communication of the present day, our forests are day by day getting more and more poor of building timber, and the time is probably not very distant when important timber of any size, such as teak, eyne, muttee and deodar will not be easily procurable, or will be beyond the reach of any but the richest people, and the prospects of the builder anything but encouraging.

While, therefore, conservation of forests and improvement of agriculture are engaging the serious attention of Government and scientific men, it behoves the Engineer that he should settle upon and gradually introduce a style of building construction, which, while satisfying the conditions of convenience, strength and durability and other comforts of a healthy abode, will require the smallest quantity of large-sized timber. The problem will perhaps be somewhat difficult of solution when economy is our first consideration.

No doubt our best hopes lie in iron. Its cost, however, is much greater than teak, which is the best building timder, and durability perhaps not more than fifty years. It is besides, at present, a material of Foreign manufacture, and the poverty of the people is a drawback against its extensive use in common buildings.

Timber and iron, after all, are perishable materials in the usual sense of the word, one subject to rot in the course of time and the other to rust and both requiring, when old, constant care and attention, costly repairs and renewals to avoid serious accidents. Considerations of better safety no less than durability and economy, therefore, make it incumbent on us that we should be awakened to the importance and desirability of hitting upon a plan which will do away with the necessity of the extensive use of these materials, especially in parts of buildings where their weakness will be a matter of serious anxiety.

G. R. T.

THE MADRAS HARBOUR.

Its Construction, Destruction, and Reconstruction.

V.

The Note "put forward" by Mr. Parkes in August 1872 appears to have been written when he had seen only Mr. Robertson's report; but when a copy of the Madras Breakwater Committee's Report was sent to him (by order of the Governor of Madras, it would appear) he in no way modified his opinion. When Colonel G. W. Walker, R.E., succeeded Colonel Orr as Chief Engineer, Public Works Department, Madras, and took up the question of a harbour, he was so struck with the saving in cost and time of construction, that would result in the adoption of Mr. Parkes' proposed cross-section for the breakwater that he recommended that he, or any other Harbour Engineer who might be consulted as to the design and execution of a harbour for Madras, should visit the port and reside there for a season to watch the effects of the changes of the monsoon currents, as well as obtain information as to the cost of materials, carriage, and labor. If Mr. Parkes did this he would then be in a position to estimate pretty accurately, with the experience gained at Kurachi, the rates at which the different items of work comprised in his system could be done. But should Mr. Parkes' cross-section be adopted for a detached breakwater, Colonel Walker thought that the economy resulting therefrom should be availed of to add to the length of the work and place it in deeper water, rather than simply to reduce its cost. On the other hand, should a closed harbour be decided on, he thought it should be headed by a detached breakwater, so as to give entrances from both north and south.

Several links in the historical chain are missing, but eventually Mr. Parkes received instructions from the Secretary of State, at the request of the Government of Madras, to go to Madras and prepare a report as to the best mode of providing shelter for shipping. Mr. Parkes arrived at Madras on 29th September, and his report is dated 4th November 1873, and during the five weeks that intervened he seems to have diligently studied the question. But before that, while at home, he had had repeated conferences with Captain A. D. Taylor, I. N., an officer of great experience as a Marine Surveyor on the Madras coast, and Mr. J. J. Franklin, R. N., for many years Secretary to the Marine Board of Madras, and with other gentlemen of local experience, and it was, he explains, as a result of the information thus obtained, that he felt himself justified in submitting his Note of 1872 to the Governor of Madras. The result of Mr. Parkes' investigations on the spot served only to confirm the conclusion he had previously arrived at in favor of the construction of a closed harbour, with a single opening to the eastward, as against the plan of a detached breakwater, but he put the cost at a lower amount than before, namely, £565,000, including 10 per cent. for contingencies and 5 per cent. for superintendence, instead of £560,000, plus contingencies at 15 per cent., or a total of £644,000. It does not appear why Mr. Parkes was in so great a hurry over his work, for his services had been secured, by agreement with the Secretary of State, for 12 months after his return to England, and the period of his stay at Madras does not seem to have been restricted by his employers. Be that as it may, there is no doubt that his stay, and study of the conditions under which the work had to be designed, was too short, for, as recorded by the Master Attendant of Madras, when he was asked for his opinion on the report, it lasted "only during a few weeks of most exceptional and unprecedented weather for the season of the year, during which time, strange to say, he had only one opportunity of seeing an average monsoon surf." Nor, of course did he in that tranquil period experience a cyclone or even an ordinary gale. But Mr. Parkes, with the help of Mr. Pogson, the officer in charge of the Government Observatory, studied the history of Madras hurricanes and gave particulars of them, from 1787 to 1872, in an appendix to his report and summarised them in the text. He found that there were three classes of cyclones with their centres passing respectively over Madras, south of it, north of it, and that only in the second of these classes (with one doubtful exception) did the wind blow from the east, in only the first—from the south, but in all—from the north. And he asserted that "strong winds never blow from the eastward at Madras except at the tails of the one" (the second) "class of cyclones." But while he maintained that there was a great preponderance of northerly wind in extraordinary as well as in ordinary weather, Mr. Parkes admitted that, of course, it was from the waves rather than from the wind that shelter was required, and that in the gradually shoaling water the waves produced by the N. N. E. wind advanced more and more from an easterly quarter. The assumption that the waves came from a direction nearly at right angles with the proposed breakwater was, he said, not borne out by the information he had received. If the question between a breakwater and an enclosed harbour depended upon this, it ought to be made the subject of more systematic observation before any precise weight could be assigned to the argument, but he had no hesitation in saying that a roadstead exposed to the most prevalent and strongest *wind*, even irrespective of the direction of the heaviest seas, could not be considered to be effectually sheltered. Remarking on Mr. Parkes' generalisation on the nature of the storms on the Madras coast, Mr. Dalrymple, the Master Attendant, said the writer was under a misapprehension. "A cyclone of the 2nd class is, as a rule, at its height when the wind is dead on shore from the eastward (then the sea is always heaviest and very tumultuous); not at the tail of it, which is when it has veered round to the southward and south-westward." If "dead on shore from the eastward" means perpendicular to the shore line, the direction of the wind at its height would be from about 17° south of east, or pointing straight into the mouth of Mr. Parkes' harbour, the shore line running about 17° east of north and west of south. As will be seen from Plate I., published with last article, Mr. Parkes' harbour as originally designed was a rectangle, with arms, projecting from the shore practically at right angles to it and closed by a break water practically parallel with it, broken midway by the entrance from the sea. He seems to have assumed that the strength of the sea would come from the north, northeast, or from slightly east of that; but he made the northern side and projecting arm of his harbour no stronger than the southern half; and when he afterwards altered the design by turning the jaws seaward to the 8 fathom line, so as to give more room inside and make the entrance easier for ships, and thus opposed the northern jaw more directly to the advance of the waves, he did not increase its strength. The direction in which the waves advanced during the storm of 12th November 1881, which wrecked the harbour, seems to have been variously estimated at from about 77° to 88° east of North, or on an average, 82°30′ E. of N., but judging from the fact that the southern jaw of the harbour and the elbow by which it curved to meet the south projecting arm were very little less damaged than the northern elbow and jaw, though owing to the alteration in the design it lay at a much more favorable angle with the line of the waves, it may be assumed that actually the sea did come in nearly due east and perhaps from the south of east, as Mr. Dalrymple said was the case in the height of a cyclone the centre of which passed to the south of Madras.

The conclusion as to the direction of the wind and sea during cyclones at Madras, which Mr. Parkes drew from his study of the records in the Madras Observatory, was used by him to show that a detached breakwater such as had been proposed by the Madras Committee and approved of by Mr. Robertson would give a very inadequate shelter to shipping as compared with that afforded by a closed harbour. He said that there existed no experience as to the comparative advantages of the two systems, nor even a theory on the subject. Mr. Robertson had said that a breakwater would give more deep water

shelter than an enclosed harbour of the same cost, and that it would create a considerable length of sufficiently smooth water at the coast line, and Sir Arthur Cotton had considered that "the breakwater would leave the space behind it exposed to a ripple from northerly or southerly winds, but *not to any swell.*" Mr. Thomas Stevenson, in his treatise on harbours, had stated that he had "been unable to find that a single observation or experiment of any kind has been made on the subject." Mr. Parkes said that whether the length of breakwater proposed, 2,000 yards, would or would not be sufficient to allow the waves coming round the ends to spend themselves and leave sufficient smooth water inside the harbour he could not positively say, but that if he were to hazard a guess, it would be that it would not be sufficient. This was on the assumption that the seas would advance to the breakwater from the eastward, or "broadside on"; but he was informed that during the north-east monsoon the waves, though they "broke" nearly parallel to the shore, had at the distance at which it was proposed to place the breakwater, a direction much nearer to that of the wind which raised them, and would therefore strike the breakwater very obliquely. This would reduce the sheltered area, and shift it south of the business part of the town. Whether the sheltered area for anchorage would actually be reduced or not by the oblique direction of the wind and sea may be questioned, though it would be altered in shape, but Mr. Parkes omitted to state that the business part of the beach might be protected by shifting the position of the breakwater farther north, to which course it does not appear that there would have been any objection. In his preliminary Note Mr. Parkes had said—"As to Mr. Robertson's assertion that a breakwater would give more sheltered area, I confess myself unable to understand his meaning. Taking into account the completeness of the shelter afforded by the close harbour, and the consequent facility for mooring the ships more closely together, I consider the superiority very materially the other way." But in his subsequent report he was not so confidant; he said "I cannot bring to any definite test Mr. Robertson's opinion that it would provide more deep water shelter than a closed harbour of the same cost. I will, however, for the moment assume that the shelter would be as complete as its advocates appear to think. On such an assumption the number of ships that could be moored on the same system would be about equal in the two cases. On the most favorable assumption the breakwater will not therefore give the superior accommodation claimed for it." Mr. Parkes' close harbour is about 3,000 feet in width, and the 3 fathom line is about 2,500 feet in shore from the entrance as originally designed, and ships could not, of course, be moored anywhere near the entrance to it. But even without making any deduction on this account the area enclosed to the 3 fathom line is only 7,500,000 square feet or 172 acres. Mr. Robertson's breakwater would have given a line of absolute shelter from the sea of twice the length—6,000 feet, and assuming that the width of smooth water would have diminished towards the 3 fathom line till it was only the width of Mr. Parkes' harbour, 3,000 feet, the protected area would have been 11,250,000 or 258 acres, or half as much again, and no deduction would have been necessary for entrance room. We confess ourselves, therefore, to use his own words, unable to understand Mr. Parkes' meaning. But this seems the less necessary, when we find that, whereas in his preliminary Note he stated that in the deep part of the harbour there would be space for 28 or 30 of the largest class of merchant ships to swing at their moorings, besides those alongside quays, in the plan attached to his subsequent report (our PLATE I.) he shows swinging room for only 13 vessels, most of these not of the largest class, and even these crowded together in an impracticable way. These vessels he states would be of from 700 to 4,000 tons each. The walls of Mr. Parkes' harbour were built only 6 feet 4 inches above low water mark, *before settlement* and he admits that during the storm which wrecked it, at least 20 feet of solid water rolled over the piers. One can imagine what would have happened had the 13 vessels then been moored inside it, with no room to pay out cable. And even for those of them that had steam power it would have been impossible to "cut and run."

(To be continued.)

NOTES FROM HOME.

(From our own Correspondent.)

THE cable system of Tramways is to be adopted in the subway between King William Street and the Elephant and Castle Southwark. It will also come into operation during the present year in Birmingham and Edinburgh, thus offering opportunities of testing the economy and advantages claimed for this method of traction as compared with horses and steam. With regard to the subway now approaching completion it is curious to compare it with the original Thames Tunnel which took 17 years to complete and cost half a million sterling against £20,000 for the new tunnel. The Bill empowering the North London Tramways to use electricity on their lines has passed the House of Lords and it is expected that in a short time Mr. Elieson's electric locomotives will be in regular work on the Romford Road between Stratford and Manor Park. So much has been said about the inability of compound engines to keep time, that it is satisfactory to find that in compounding there is nothing to prevent the fastest trains being worked. The passenger compound engine used to work the Scotch Express has been found too powerful for its work, making more steam than is required and easily attaining a speed in its regular work greater than time-table requirements. While on this subject I may note some detail drawings of Mr. Worsdell's engine appearing in the "*Engineer*," a longitudinal section of which was given in a recent issue of that journal.

A scheme is being promoted under which vessels of two thousand tons will be able to enter upon any tide and navigate a channel direct to Gloucester. It is proposed that some of the Midland Towns with Cardiff and Swansea should combine in purchasing and improving the Gloucester and Sharpness and the Birmingham and Worcester Canals, and that a new entrance should be constructed in the channel five miles below the present docks at Sharpness, direct communication being obtained to Gloucester by constructing a new ship canal to the mouth of the Gloucester and Sharpness canal. The estimated expenditure for the proposed undertaking is about a million and a quarter.

The exhibition of American Industries is to be held this year at Earls Court. The material of the South Kensington Exhibition has been sold by public auction. The new exhibition is to be opened on May 2nd and as soon as the electric plant is fixed, for which a 600hp. engine and boiler are being put into place, work will proceed by night. The buildings and grounds occupy an area of nearly 23 acres and in the grounds there will be a model of the celebrated switchback Railway in Pensylvania. Not the least interesting exhibit of the American exhibition will be the manufacture of machine-made watches and clocks for which the United States is famous.

The protracted and obstinate fight last year over the Hyde Park Corner Bill is likely to be renewed this session and the Metropolitan Board are resolved again to resist it. The main point at issue is the question whether the cost of maintaining the new streets shall fall entirely upon the parishes concerned or partially on the Board of Works.

The last meeting of the Institution was occupied with a paper on Irrigation in Lower Egypt. In the discussion thereon which followed some very interesting facts were given shewing the good results which had grown from the British occupation of the country in managing this most important matter of irrigation in the Nile country.

The Telegraph Engineers have concluded the discussion at their meeting at the Civil Engineers' Institution, on the paper on Telephonic Investigations.

A Commission of Enquiry has been appointed in Ceylon to ascertain the causes believed to have contributed to the collapse of the Yaligakanda tank, and, if possible, to suggest some means for mending it.

A Home paper hears that a concession is about to be granted by the Persian Government to a British Company for the establishment of a line of steamers on the Kiroon River, which runs into the Persian Gulf from the north. This river is navigable for a distance of about 150 miles from its mouth opposite Bushire.

JODHPUR PUBLIC OFFICES.

THE Design bearing the motto "Pro Bono Publico" has been prepared in compliance with an advertisement inviting Designs for Public Offices at Jodhpur and in accordance with a printed memorandum dated 14th May 1886 stating the conditions to be fulfilled.

The accommodation required by the memorandum is noted below, and an index number is put to each room and on the plans herewith submitted, to facilitate reference. It will be seen that the design consists of—

One mainblock of two storeys in the centre with extra rooms spare above.

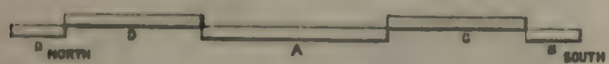
One block of one storey in each side of it and one block of two storeys at each end.

The centre block to facilitate reference is called A.

The single storeyed blocks on each side of it C and D.

And the block of 2 storeys at each end B North and B South.

The building is supposed to face the west, and the general arrangement as shewn in the index plan is as follows.



Elsewhere will be found statements shewing the accommodation provided in each block; it will be seen that the requirements have been fulfilled and some extra accommodation has also been provided, which though not required by the memorandum, will, it is believed, be found to add much to the usefulness and convenience of the building.

The following advantages are claimed for this design.

1. No rooms cover one another, all the main rooms face the prevailing breeze, and are so situated that tatties can be used in them—the fan lights over the doors or the clerestory window which gives light when a tatti is used at the doorway.

2. No span is more than 10 feet so that local slabs for roofing can be used, and it will not be necessary to import iron girders.

3. Every room is provided with a verandah in front and rear, which will help to keep the main walls cooler.

4. Every room has a separate entrance and separate portion of verandah, so that those whose business concerns any particular office need not be inconvenienced or interfere with the other offices, and the attendants of each office can remain in the verandah near their own particular office.

5. The offices which are most likely to be largely attended such as the Foujdari Court and the Civil Court, Settlement Office, Geerai Office, Customs Office and Piyad Bukshi, have been placed at end of the line, or of each block, so as to have plenty of space round them.

6. The arrangement proposed of throwing back the blocks C and D admits of the ends of these blocks and of the blocks adjacent being opened to light and air and of easy access; besides adding to the general appearance of the buildings by breaking up the long front so as to admit of lights and shadows.

7. Covered passages large enough for carriages to pass have been provided in the centre of the main block A and also in the centres of blocks C and D, so that there may be no inconvenience in passing from front to rear of the building, and while forming a feature of the design will no doubt be found very useful and convenient.

8. The advantage of having some of the blocks such as C and D of one storey only is that if extra accommodation is required at any time it can be easily added by putting upper rooms on these blocks or by throwing out rooms in rear without altering the front of the buildings.

9. A special room in the centre block on the first floor near the entrance has been provided for the use of H. H. the Maharajah, should he desire at any time to visit the offices, and on the roof above, and clear of all the other rooms, three extra rooms and a Bara Darie above all have been added for the same reason. There would be an extensive view from these rooms, and owing to the screen walls which connect them, there is perfect privacy, so that they could be used by the ladies of the court—supposing occasion should ever arise, such as a general review of troops, &c., which they might like to see.

10. Special provision has been made for keeping records; should this however prove insufficient, record rooms could be easily added over blocks C and D or in the rear verandahs.

11. Accommodation has been provided for guards in main entrance and for the sentries on duty so as not to block the roadway.

12. Staircases have been provided to admit of access to the roofs of C and D, and Bara Daries have been also provided on each roof; and these may be found convenient places for discussion of any questions which concern two or more offices or for Panchayats.

13. In the Civil Court and Foujdari Court the rooms have been so arranged by an archway between them that, if necessary, the two rooms can be thrown into one and form a large and suitable court and are provided with a verandah or covered passage on both sides to allow sufficient space for attendants outside the court.

14. The estimates amount to Rs. 3,48,796, which is within the limit allowed, *viz*, 3½ lacs; full rates have been taken. and 5 per cent, equivalent to Rs. 16,609, have been included for contingencies in the estimate.

S. S. JACOB, LT.-COL.

[We regret that, the *reduced* scale of our Illustration renders inadequate justice to the original drawings. The Specification, Abstract, Memorandum, and other particulars will appear in succeeding issues —ED. *I. E.*]

THE RED SPECTRE.

THE world, as we look through its long list of centuries, seems greatly to have wasted its time. Whether we count its years by the hundred thousand, or whether we content ourselves with a modest five or six thousand, we do in any case see that in the last small percentage of its life it has accumulated a very large percentage of its knowledge. Had this world of man for the last two thousand years made progress at such a rate as the last two hundred have shown, most of the problems which now beset the statesman or the man of science would have ceased to trouble for solution.

One of our modern political tools is the method of government by party. If we roughly divide our ordinary politicians into Tories, Whigs, and Radicals—avoiding the question begging epithet of 'Liberals' since Liberals most frequently evince their liberality by suggesting disbursements from others—we must take note that while these political parties preserve a kind of corporate identity—or keep their apostolical succession—their doctrines are also like the doctrines of churches receiving convenient changes.

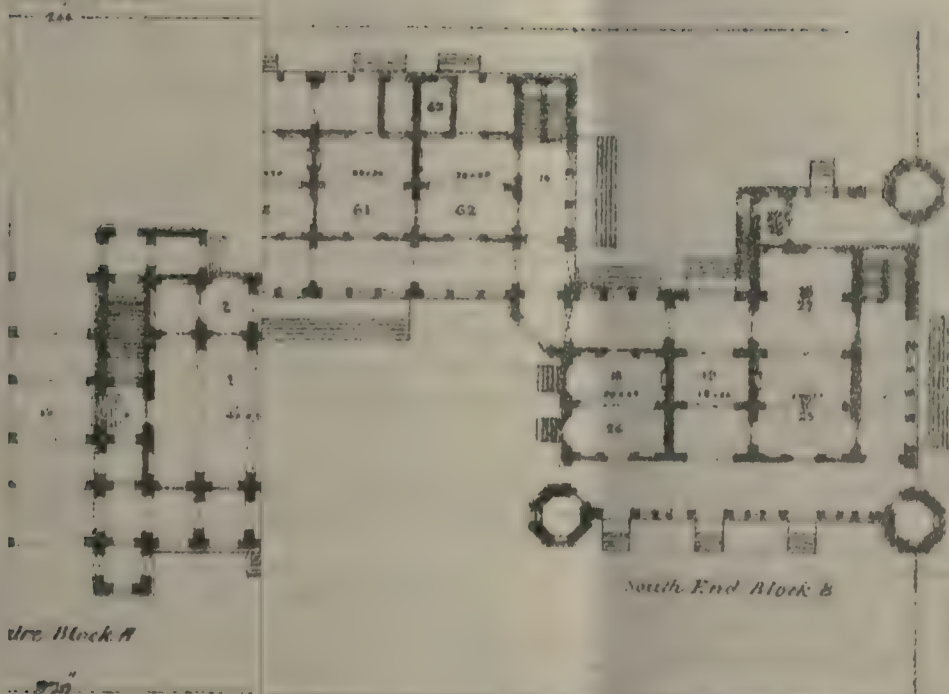
The modern history of political doctrine in effect is somewhat panoramic. Radical measures vague and distorted enter at one side. Passing over the centre they become transformed—their outlines and features seem Whig. Finally they disappear at the other side in a glow of Tory light.

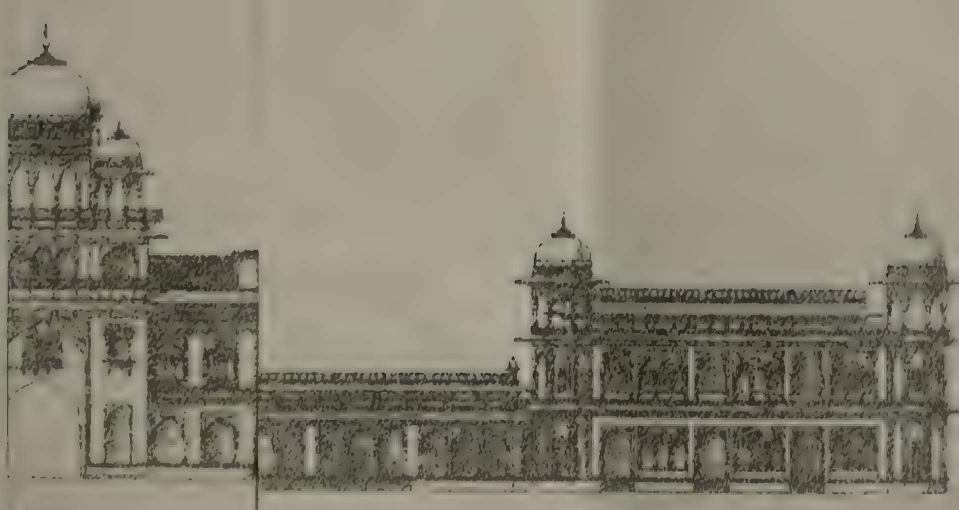
If for the moment we consider old-fashioned Toryism as the most aristocratic of political convictions, we may then descend through the level of the Whig and find ourselves at the level of the Radical. Below this, however, there is a lower level which is occupied by the Socialist. Below this, again, there is a lowest level and on it there dwells the Anarchist. In a modern drawing-room a well-dressed man may accost you and incidentally may avow himself an Anarchist. Should you instinctively throw yourself into an attitude of defence he may politely reassure you as to the safety of your throat and may add in further explanation that his business is to calculate for the functions of Government a certain

PUBLIC OF

HPORE

RAL PLAN





VATION

40 feet Inch

irreducible minimum which shall be in the neighbourhood of zero.

The thoughtful student of the growth of communities does not feel it desirable to place himself permanently at any one of these five levels. He commits himself to the elevator, reaches each floor in succession, listens to what that floor will tell him, and finally draws his own conclusions. On the opening page of his note book he lays down the following postulate : "Let it be granted that if in different countries and under different conditions there grows up a considerable body of men who are prepared to sacrifice their comfort and to risk their lives in the passionate advocacy of some new doctrine—be it religious, moral, social, or political—it is highly probable that somewhere hidden in the extravagancies of this doctrine there dwells a soul of truth."

Let us suppose that on a small island fifty persons—say twenty-five men and twenty-five women—are living in extreme poverty. To one of the men let there come, by lawful inheritance, property to the value of one million sterling. Let the property when it arrives at the island be found to consist of some wooden houses—such as are constructed in Norway—and a quantity of clothing and preservable provisions with other comforts and luxuries. Let the newly made millionaire decide in his own mind that everything is his to do with it exactly as he pleases. Let him choose for himself the most comfortable house and determine to burn the others. Let him in like manner set aside such clothing, food and other commodities as he thinks will last his life, and let him prepare to sink the remainder in fifty fathoms of seawater. There is, of course, no manner of doubt that the rest of the population will interfere. But have they a right to interfere ? We hold that they have. At this point of the argument the ordinary unscientific politician will contemptuously explain that the discussion of such impossible contingencies is simply a waste of time. But the few politicians who are scientific—*rari nantes in gurgite vasto*—will see that to a certain important principle—we have supplied an illustration which really amounts to a proof. This important principle may be thus enunciated: "The rights of property are never absolute."

Let us return to our tiny island. Let the forty-nine persons—men and women—march in a body to the millionaire and address him to the following effect: "You have become enormously wealthy, but we all remain poor. We have decided to divide your property into fifty parts and one of these you may keep. We have left you one of our women whose dowry is a fiftieth of the property. The other four dozen have become betrothed and in a short time the population will amount to a hundred. We shall then redivide the property, men, women and babies being apportioned equal shares. Possibly by the labour of some of us there may by then have been made an increase to the wealth. But on that matter we make no promises As the population continues to increase by successive increments of fifty we shall—subject to further deliberations—repeat the subdivision of the property. Hand over the keys of your treasure." Let the millionaire place himself behind a loaded cannon kept in readiness for this anticipated aspect of affairs. Let him reply somewhat as follows : "I will be no party to this lazy socialistic programme. If a man will not work neither shall he eat—at least at my expense. If you value your lives, keep back." Let the crowd rush at him to execute their plan and let him blow them all into space. Has he a right to do so ? We hold that he has. Here then we see illustrated a second important principle: "The rights of a majority are never absolute." Thus between the Scylla of absolute personal egotism and the Charybdis of absolute Socialistic uniformity it behoves the modern owner of property wisely to steer his craft.

A state of society in which the few—mainly by inheritances—are enormously wealthy and in which a great majority spend lives of cruel poverty, is a state which is not healthy and which it will be difficult to maintain. We must not picture to ourselves the wealthy man as a sort of coarse Midas—eager to invent irrational modes of dissipating his vast resources because he cannot in rational modes spend all his money on himself. Cases of this kind do exist, but they are not representative of the class. Equally must we avoid assuming that the poor man is always sober and self-respecting—that he is anxious always for honest work, but frequently unable to obtain it—that he bears his privations with manly fortitude—and is only at times excited to frenzy by the sight of his children starving. Cases of this kind do exist and, indeed, are painfully numerous. Nevertheless, they do not so preponderate as to be representative of the class. The possession of wealth tends to cultivation and refinement—the tendency of poverty is to degrade and brutalise. It is easy to sympathise with the best type of the starving industrious workman. The difficulty is to sympathise with those fouler specimens of degraded humanity for which the larger cities of Europe are practically so many manufactories. Is it an easy matter to lay down rules by which for these men—or rather for their children—the process of manufacture shall be bettered ? No statesman has yet succeeded; so the question must needs be difficult. Yet this is the question to which our Socialists, our Anarchists and our Nihilists—our red Revolutionaries of every shade—are with menace demanding a reply.

THE CONSTRUCTION OF THE HONEY-CELL ;

OR,

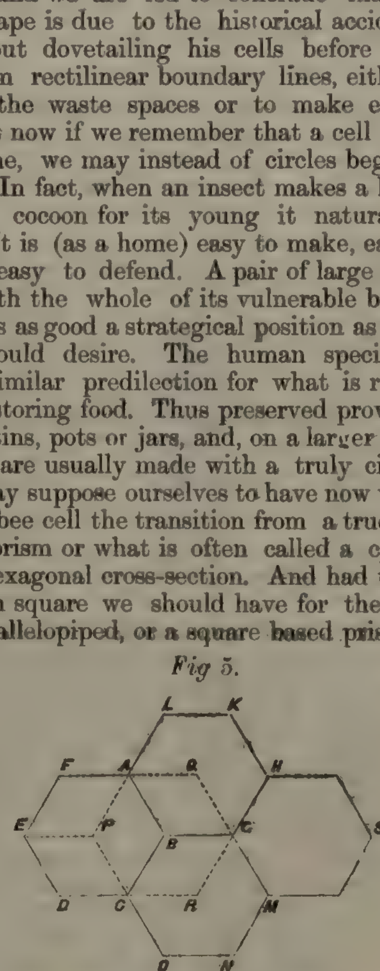
THE BEE AND HIS D. P. W.

BY A. EWBANK.

III.

HITHERTO we have dwelt entirely on the section of the honey cell, and we are led to conclude that its present sectional shape is due to the historical accident that the bee set about dovetailing his cells before he set about giving them rectilinear boundary lines, either to absorb completely the waste spaces or to make each wall serve twice. But now if we remember that a cell is not an area, but a volume, we may instead of circles begin to speak of cylinders. In fact, when an insect makes a home for itself or cradle or cocoon for its young it naturally chooses a cylinder. It is (as a home) easy to make, easy to enter or leave, and easy to defend. A pair of large nippers at the entrance with the whole of its vulnerable body in retreat behind gives as good a strategical position as a Napoleon or a Moltke could desire. The human species is believed to have a similar predilection for what is round when it is bent on storing food. Thus preserved provisions are put into *round* tins, pots or jars, and, on a larger scale, vats and gas holders are usually made with a truly circular section. Thus we may suppose ourselves to have now watched in the case of the bee cell the transition from a true cylinder to a hexagonal prism or what is often called a cylindrical surface with hexagonal cross-section. And had the bees made their section square we should have for the cell a rectangular parallelopiped, or a square based prism.

Fig 5.



In *fig. 5* we have a small group of cells shown in plan or section. For convenience of language we shall consider the plane base of each cell to be horizontal, *i.e.*, we shall suppose the cell walls to be vertical. If the base is modified and ceases to be a plane area we shall still have the upper part of the cell provided with vertical walls. A cell with its upper end open and its lower end

closed we may call an erect cell. If the upper end is closed and the lower open we may call it an inverted cell. We are not considering the orienlation (or position in respect of direction) of any cell as it actually exists in the honeycomb. In *fig.* 2, we may suppose that the bees first built a row of cells E, Y, Z . . . . . and then a second row S, T, ...

In *fig.* 5 we may (geometrically) suppose any one hexagon built and then others built round it. Such a group as *fig.* 5 denotes we may call a layer of cells and their plane bases make one plane lamina of wax. Now instead of adding on fresh erect cells so that F E, L K, . . . are made to do duty twice, we might cease to extend this layer, but build another layer back to back so that we have a new layer of inverted cells. This to some extent saves material as a base does duty twice. But the economy is not so marked as when every vertical wall does duty twice. If nature had supplied bees with level extensive mahogany tables or level slabs of rock or other suitable sites—if nature had put these in such places as were sheltered from rain or from wind, which means dust inconvenient for honey, and had nature provided an absence of wandering dacoits of the insect, feathered, bruin or human species—then it is probable that the honeycomb would consist of one extensive layer of cells whose bases were plane areas, whose walls were vertical, and whose openings were all at the top. But as it is, bees like other folk, have "criminal classes" to think of, and as holes in the roots of trees or casual caves in rocks are not generally of the slab-like shape, they find it convenient to double up their store houses by arranging them back to back. Thus in *fig.* 5 we may suppose ourselves looking not only at a layer of erect cells of which the diagram may give the floors, but also at a layer of inverted cells, of which the diagram shows the ceilings. Here each individual cell has its one companion cell fastened to it—back to back.

surfaces bite into each other. As long as the closed ends of each layer are plane faces the dovetailing idea seems imperfectly realised. That dovetailing arrangement by which *fig.* 2 differs from the original type contemplated in *fig.* 1 is an arrangement by which one row of cells is prevented from being shifted bodily to the right hand or the left. As accidents may happen to the best regulated honeycombs the dovetailing arrangement of *fig.* 2 is preferable to the complete absence of dovetailing as shewn in *fig.* 1, not so much for the geometrical reason of diminishing waste space, but engineeringly for the increased solidarity given to the whole structure. Therefore also the bees on *engineering* grounds sought to introduce a zig-zag or saw-like arrangement into the closed ends of the cells, so that one under cell might be jammed or wedged between two or more upper cells, and so the solidarity of the whole honeycomb be more firmly established.

To understand how they came to the new arrangements let us consult *fig.* 6. A B C D is an open rectangle. It may also represent in elevation a rectangular vessel. We will call A B the height and B C the breadth and thus the length is unrepresented and indeterminate. F bisects B C and E F C = 90°. Take G B = H C = F E. Join G E, E H. Then the open rectangle is replaced by an open five-sided figure, or the vessel acquires a two-sided sloping base. Thus the rectangle is replaced by a figure of equal area. For we lose the areas G B K, H C N and acquire as much elsewhere. Therefore, the new volume of the vessel equals the old. In the rectangle however we may chance to economise perimeter. Let $B C = 4b$ and let $F E = x$. Then the perimeter dispensed with is $2x + 4b$. New perimeter added is $4\sqrt{b^2+x^2}$. There is economy if $2b + x > \sqrt{b^2+x^2}$ or $4b > 3x$, as we see on squaring and simplifying. Thus for small values of x we economise material. If we suppose the value of x to in-

Fig 1.

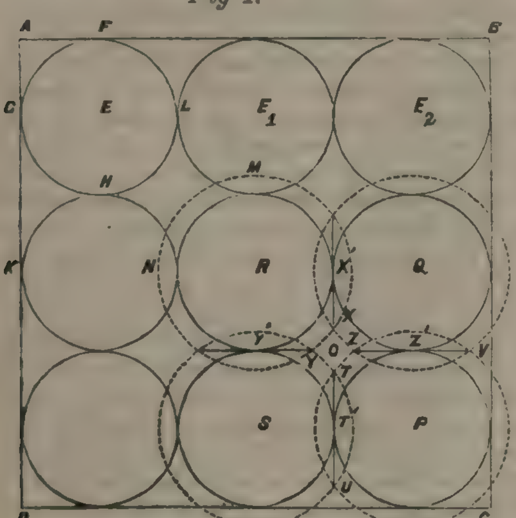
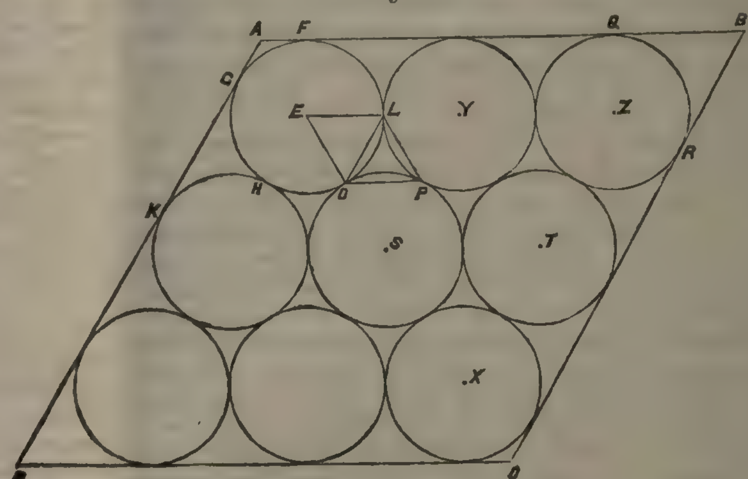


Fig 2.

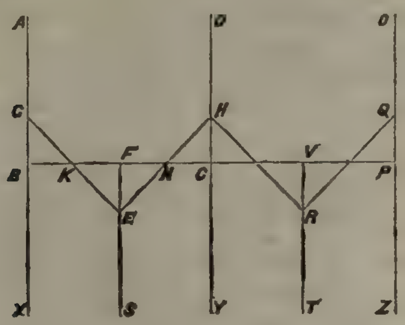


Now this back to back arrangement of cells reminds us somewhat of the arrangement of *fig.* 1. And just as the bees declined or deserted that arrangement for the dovetailing arrangement of *fig.* 2 so they introduced a sort of dovetailing arrangement into the back-to-back layers. In *fig.* 5, P, Q, R, are the centres of three contiguous hexagons. The figure shows that out of these three hexagons we might construct a new hexagon P A Q G R C. Here each original hexagon contributes one-third part—a rhombus—to the new figure. B, the common point for the three original hexagons, becomes (in plan) the centre of the new hexagon. This new hexagon is the ceiling or closed section of an inverted cell. Thus the walls of the new inverted cell are not the prolongations of walls of the original erect cells. While A B is the wall in plan of an original cell, A P is the wall in plan of an inverted cell. The new cells are in a manner dovetailed between the old ones. But the word dovetailing means more than such a mere shifting of the second layer as we have just contemplated. Dovetailing implies that two serrated

crease very slowly from zero, that is—for time is not the element we are studying—if we suppose x to increase by small equal increments, each increment gives us a new pentagon whose perimeter is less than its predecessor. This continued improvement in economy lasts till x attains a certain value. Trial would show that this value of x is $\frac{b}{\sqrt{3}}$. If x increases beyond this value the perimeter begins again to increase. Finally as x reaches the value $\frac{4b}{3}$ (as found above) the perimeter has regained its initial value, *viz.*, B C + 2 A B. Similar remarks apply to the vessel denoted in elevation by A B C D or A G E H D. We might therefore suppose an insect constructing a cell so as to have A G E H D for elevation. If it (or its descendants) gradually increased the value of x, starting from the value zero, they would finally reach that particular value which is most economical of material. If then there was no engineering

reason why they should go on increasing the slope of G E they might accept the slope that gave the perimeter a minimum.

Fig. 6.



We have dwelt on this case because it helps to illustrate the changes which the bees gradually introduced into the honey cell. Now let us have two such rectangles (or vessels) A C, C O. Back to back with these let us put two other vessels B C Y, Y C P. This would be like what we call the *fig.* 1 arrangement. There is neither perfect nor imperfect dovetailing. An imperfect dovetailing would give us the figure S F V T. In a perfect dovetail we take E H half of the base of one vessel and R H half the base of another vessel. These give us a new base E H R for a perfectly dovetail vessel S E H R T. By keeping for F E the value $\frac{b}{\sqrt{3}}$ we have effected the greatest possible saving of material—which, if common mud is not worth saving, but if wax or other substance secreted or with difficulty collected, *is* worth saving. But we have also obtained a more stable architecture and this it appears to us is the main object at which the insect would aim. When he found that his engineering improvements were also improvements in economy he would or might be encouraged to persevere and perhaps to carry the modifications further than on mere engineering grounds he would consider necessary. If the insects at work on the A F and O V cells decided to make them protrude downwards to get a grip on the opposite layer, the insects at work on this opposite layer would soon see the convenience of shifting their cells a little. Otherwise a corner K E N in the one layer would give a spike or re-entering angle in the opposite layer and by avoiding the two appearing spikes at E and R the opposite cell would naturally slide into the dovetailed position.

We need not suppose that these engineering ideas occurred simultaneously to the whole body of workers. Everybody who studies elephants, horses, dogs, parrots, canaries, ants, or other animals discovers that the individuals of any one species differ remarkably among themselves in intelligence to originate improvements or in teachability to borrow them from others. The analogy also of the "humans" forbids us to assume that all bees always were equally skilful or wise. Many definitions have been proposed for man to define his place among animals. I propose to define him as a tailless biped that gives dinner parties. Now among these bipeds we see that new ideas only occur to a few select specimens. When one of these select specimens has formed a new idea and busies himself with tongue and antennæ to communicate the ideas to his fellows, we see that they immediately put themselves into an attitude of defence as if instead of a new idea it was some new missile that was coming at their heads. The idea when it reaches them they clearly see to be impossible or if impossible very undesirable. Afterwards they accept the ideas and usually consider that such acceptance has laid the eager exponent under personal obligations to them. Lastly the new idea gets gradually old and becomes a truism. Then they resent the suggestion that they were not its adherents from the first. This little comedy is daily being enacted among small communities of men.

Similar argumentative conflicts probably arose in the early history of the bees. We have seen them *first* dovetail their unaltered circles and *then* carry the dovetailing further to absorb the waste spaces. It is not likely that this further dovetailing, involving as it did a desertion of the time-honoured—the "constitutional"—circle, was accepted without strenuous opposition. Probably some conservative bees of high respectability pointed out amidst the applausive buzzing of their party that nature had pre-appointed the circle as the most perfect of figures and that to desert it was treason and impiety. Thus we know that when the dinner giving tailless bipeds first proposed to drive steamers across the Atlantic it was pointed out by others of this species that if God made the wind to blow one way and the Engineer drove his steamer the other way he was flying—or rather steaming—straight in the face of Providence. Providential winds however continue to blow and the steamers work straight through them, often to the enhanced comfort of passengers, who in hot latitudes are wont to pray for a stiff head wind. Well, the conservative bees entered their sorrowful protest against the radical tendencies of the age to utilise waste spaces. But the progressive instincts carried the day as indeed they usually do even among the tailless dinner-giving bipeds.

(*To be continued.*)

THE USES OF KIESELGUHR.

[Translated from *Le Monde de la Science et de l'Industrie*, for INDIAN ENGINEERING.]

ON the heath of Luneburg in Hanover, there are to be found in several places, deposits of kieselguhr or amorphous sileo in an almost unalloyed state, which have been formed by the remains of an infinity of diatomaceœ. (These are alguæ and not infussoria as was at first supposed). These deposits of earth possess many important properties, which render it most valuable with regard to various industrial applications.

Kieselguhr has, in the first place, the power of absorbing large quantities of liquid; the fact of its possession of this property is the reason it is so much employed in the preparation of dynamite. Besides this, it is a non-conductor of heat, and its specific gravity is very small; (one cubic metre, or 35 cubic feet, weighing from 80 to 165 pounds only).

The most extensive deposits on the heath of Luneburg are at present in the hands of the firm of G. W. Reye and Son, of Hamburg, which firm also owns the works of Neu-Ohe not far from Unterluess, near Celle, and those of Huetzel in the neighbourhood of Soltan and Emmingen on the way from Magdeburg to Halberstatt. This house gives in its latest catalogue a list of the various purposes for which kieselguhr has been used up to the present time. The number and the variety of these are truly astonishing. It will be sufficient to notice here those that come into the scope of our journal.

Kieselguhr is extensively employed in building. In consequence of its non-calorific conductibility, it forms an excellent protection against both the heat of summer and the cold of winter. It can be used for the protection of entire dwelling houses by building double walls and filling with kieselguhr the intervening spaces, which should be of the width of 7 centimetres. It can be used for the roof only by covering it with a protecting layer of the earth. Houses thus protected are as suitable in a tropical as in a cold country. The towns of Russia import large quantities of kieselguhr for building purposes.

This substance is also of great value for filling up the spaces between planks. In the first place, ravages of insects and growths of fungi, very frequent when inferior materials are employed, are rendered impossible by its use; and the cost of building is considerably lessened by this means. Kieselguhr serves, moreover, as a protection against the heat, and by reason of its absorbing powers, does not allow water to penetrate. It is at present largely employed in subterranean ice-houses, in breweries, and in slaughter houses; dividing layers being placed inside the walls, and it is used in the same way for beer and meat vans.

On the other hand, a great economy of combustibles may be realised in the heating of boilers, by covering them after building, with kieselguhr instead of with clay or loam, sand, or plaster.

On board steamers, the fire-room is separated from the cabins of the passengers and from the hold where the cargo is stored by a division filled with kieselguhr, diminishing the risk of fire by the incombustibility of this silicious earth. For brickwork on ships, light artificial stones capable of floating on water are used, made by kneading in wooden frames, a mixture of kieselguhr and a little brick clay, which is then dried and burnt as ordinary bricks. In packing up articles of food, which must be preserved fresh during the transport by sea from country to country, such as meat, vegetables, and fruit, they are placed in kieselguhr. If despatched in tin boxes, these latter are made slightly smaller than the outer cases and the space between is filled with keselguhr. Beer, mineral waters, chemicals, and essences, are sent out in bottles which have first been well wrapped in paper, and then placed in kieselguhr, so as not to touch each other.

Mixed with kieselguhr, sulphuric, nitric and muriatic acids, can be despatched as solid substances. This method of packing is suitable for sending by sea. Kieselguhr absorbs three and four times its own weight of sulphuric acid at 66°, double its weight of muriatic at 20°, and of nitric acid at 36.° Spirits of wine and petroleum can be solidified by mixing them with the earth and thus diminishing the risks of explosion. This application of kieselguhr would also suggest certain advantages with regard to the heating of boilers.

Casks, barrels and hogsheads can be rendered water and airtight (particularly those containing tallow) by a handful of Kieselguhr being rubbed on the parts where the iron hoops are to be fixed; and at the first blows of the hammer, the hoops attach themselves as solidly as could be wished.

Finally, kieselguhr moistened with water will in a few instants, perfectly cleanse the dirtiest and most greasy glass plates and dishes. Bottles which have contained oils and resin can be cleaned in a very short time by kieselguhr moistened with benzoine or sulphuric ether.

A. A.

The Gazettes.

PUBLIC WORKS DEPARTMENT,

India, March 26 1887.

The Governor-General in Council is pleased to order the following appointments and transfers :—

Colonel C. M. Browne, R. E., Chief Engineer, 2nd class, and Secretary to Chief Commissioner, Burmah, to Bengal, as Officiating Chief Engineer and Secretary to the Government, Public Works Department, Bengal, *vice* Colonel S. T. Trevor, R.E., on furlough.

Colonel J. P. Steel, R. E., Superintending Engineer, 1st class, and Secretary to the Agent, Governor-General, Rajputana, Public Works Department, to Punjab, as Officiating Chief Engineer and Secretary to the Government, Public Works Department, Punjab, *vice* Colonel Perkins, R. E., on furlough.

Major G. F. L. Marshall, R. E., Superintending Engineer, 2nd class, temporary rank, Under-Secretary to the Government of India, Public Works Department, to Rajputana, as Officiating Superintending Engineer and Secretary to the Agent, Governor-General, Rajputana, Public Works Department.

Major W. G. Cumming, R. E., Superintending Engineer, 3rd class, on return from furlough, to Burmah, as Officiating Secretary to Chief Commissioner, Burmah, Public Works Deparment.

Colonel S. S. Jacob, Bombay Staff Corps, Executive Engineer, 1st grade, Rajputana, employed under the Jeypore State, is appointed to officiate temporarily as Superintending Engineer and Secretary to the Agent, Governor-General, Rajputana, Public Works Department, in addition to his own duties.

Central India.

Major H. H. Cole, R. E., Executive Engineer, 1st grade, is temporarily deputed to Gwalior State for special duty, for six months.

Director-General of Railways.

Mr. J. Adam, Assistant Engineer, 2nd grade, is posted to the North-Western Railway.

North-Western Railway.

Mr. A. Morse, Executive Engineer, 4th grade, temporary rank, is granted furlough for eighteen months.

Mysore, March 19, 1887.

Mr. R. F. Scaldwell, Executive Engineer, Palace Division, is granted privilege leave for 3 months, with effect from the 4th February 1887.

Madras, March 22, 1887.

Colonel H. R. Mead, R.E., to be Chief Engineer for Irrigation and Joint Secretary to Government, Public Works Department, Irrigation Branch.

The following promotions and reversions are ordered :—

Colonel H. R. Mead, R. E., Superintending Engineer First Class, to be Chief Engineer, Second Class, with effect from date on which Colonel H. R. Mead assumes charge—Permanent.

Lieutenant Colonel J. Pennycuick, R. E., Chief Engineer Second Class, sub. *pro tem.* to be Superintending Engineer, Third Class with effect from date on which Colonel H. R. Mead assumes charge—Permanent.

Mr. J. W. Randall, Superintending Engineer, Second Class, to be Superintending Engineer, First Class, with effect from date on which Colonel H. R. Mead assumes charge—Permanent.

Lieutenant-Colonel J. Pennycuick, R. E., Superintending Engineer Third Class to be Superintending Engineering Second Class, with effect from date on which Colonel H. R. Mead assumes charge—Permanent.

Mr. G. T. Walch, Executive Engineer First Grade, to be Superintending Engineer, Third Class, with effect from date on which Colonel H. R. Mead assumes charge—Permanent. Continuing as Superintending Engineer, Second Class, temporary rank.

Colonel W. H. Burton R. E., Superintending Engineer Second Class temporary rank, to be Superintending Engineer, Third Class with effect from date on which Colonel H. R. Mead assumes charge—Sub. *pro tem.*

Mr. G. D. Wybrow Executive Engineer, First Grade sub *pro tem* to be Executive Engineer, First Grade, with effect from date on which Colonel H. R. Mead assumes charge—Permanent. Continuing as Superintending Engineer, Third Class temporary rank.

Mr. J. Grimes, Executive Engineer, Second Grade, sub. *pro tem*, to be Executive Engineer. Second Grade, with effect from date on which Colonel H. R. Mead assumes charge—Permanent.

Mr. J. Traill, Executive Engineer, Third Grade, sub *pro tem*, to be Executive Engineer, Third Grade, with effect from date on which Colonel H. R. Mead assumes charge—Permanent.

Mr. C. H. B. Burlton, Executive Engineer, Fourth Grade, sub. *pro tem*, to be Executive Engineer, Fourth Grade, with effect from date on which Colonel H. R Mead assumes charge—Permanent.

Major A. C. Smith, R. E., Superintending Engineer, Third Class, sub, *pro tem*, to be Executive Engineer, First Grade, with effect from date on which Colonel H. R. Mead, assumes charge—Permanent.

Major D. Campbell McNeil, R. E., Superintending Engineer, Third Class, sub. *pro tem*, to be Executive Engineer, First Grade, with effect from date on which Colonel H. R. Mead assumes charge—Permanent.

Mr. J. W. Martin, Superintending Engineer, Third Class, temporary rank, to be Executive Engineer, First Grade, with effect from date on which Colonel H. R. Mead assumes charge—Sub. *pro tem.*

Mr. J. J. Whiteley, Executive Engineer, Fourth Grade. temporary rank, to be Assistant Engineer, First Grade, with effect from date on which Colonel H. R. Mead assumes charge—Permanent.

Captain L. Langley R. E., Executive Engineer, Third Grade, to be Executive Engineer, Second Grade, with effect from date of relief of Captain C. B. Henderson R. E.,—Sub *pro tem.*

Mr. A. S. Russell, Executive Engineer, Fourth Grade, to be Executive Engineer, Third Grade, with effect from date of relief of Captain C. B. Henderson, R. E., —*pro tem.*

Mr. C. J. Ussher, Assistant Engineer, First Grade, to be Executive Engineer, Fourth Grade, with effect from date of relief of Captain C. B. Henderson, R. E.,—Sub *pro tem.*

Mr. J. J. Whiteley, Assistant Engineer, Fourth Grade to be Executive Engineer, Fourth Grade, with effect from date of relief of Captain C. B. Henderson, R. E.,—Temporary rank.

The following posting is ordered :—

M. R. Ry. Gopala Aiyar Avergal B. A., Assistant Engineer, Third Grade, Probationary, to the VI Circle, for duty in the Madura Division. To join at the public expense.

The following transfer is ordered :—

Mr. J. E., Paul Executive Engineer, Fourth Grade, from the Godavari Western Division to the Godavari Eastern Division. To join at the public expense.

Bombay, March 24, 1887.

Lieut-Gen W. W. Goodfellow, C.B. R.E., vacates his appointment in the Public Works Dept. on promotion to the rank of Lieut.-Gen, on 31st March 1887, and his services are replaced at the disposal of Government in the Military Department from 1st April 1887.

Official intimation having been received from the Secretary of State for India of Colonel J. LeMesurier's promotion to the rank of Major-General, with effect from the 22nd February 1887, his services are replaced at the disposal of Government in the Military Department, with effect from the date of his being relieved of the duties of Superintending Engineer for Irrigation in Sind.

H. E. the Governor in Council is pleased to appoint Mr. J. Tate, on his return from furlough, to act as Ex Engineer Hyderabad Canals, vice Mr. G. N. R. Lambert, appointed to act as a Superintending Engineer for Irrigation in Sind.

N. W. P. and Oude, March 26, 1887.

Irrigation Branch.

With reference to Government of India, Public Works Department, Notification dated 16th March, 1887, temporarily promoting him to the rank of Superintending Engineer, 3rd class, Major F. V. Corbett, R.E., is appointed to the charge of the 3rd Circle, Irrigation Works.

Mr. R. W. L. Hawkins, Executive Engineer, 3rd grade, Sub *pro tem.*, is appointed to the charge of the Betwa Canal Division, *vice*

Major F. V. Corbett, R.E., temporarily promoted to Superintending Engineer.

Burma, March 19, 1887.

With reference to *Burma Gazette* Notification dated the 10th March 1887, Mr. E. W. Oates, Executive Engineer, First Grade, made over, and Mr. W. R. Gilbert, Executive Engineer, Third Grade, substantive *pro tem.*, received, charge of the Tharrawaddy division on the afternoon of the 8th March 1887.

Mr. J. W. Buyers, Superintending Engineer, reported his arrival at Rangoon on the forenoon of the 6th March 1887, and took over charge of the office of Manager and Engineer-in-Chief Burma State Railway, from Mr. H. M. Mathews, C. I. E., on the afternoon of the 16th idem.

Mr. H. M. Mathews, C.I.E., Manager and Engineer-in-Chief, Burma State Railway, is granted 10 days' subsidiary leave, previous to retirement, with effect from the afternoon of the 16th March 1887.

With reference to *Burma Gazette* Notification dated the 21st February 1887, Mr. R. Ring, Executive Engineer, First Grade made over, and Mr. E. W. Oates, Executive Engineer First Grade received, charge of the Rangoon division ou the afternoon of this date.

Mr. J. C. Wyatt, Evecutive Engineer, Fourth Grade sub. *pro tem.*, Tharrawaddy Division, is granted 36 days' privilege leave, with effect from the 28th instant.

Burma State Railway.

With reference to Director-General of Railways' Notification dated the 2nd February 1887, Mr. F. W. Roberts, Assistant Engineer, Second Grade reported his arrival in Rangoon on the afternoon of the 14th instant and is posted temporarily to the "C" Survey Division, Toungoo-Mandalay Extension.

Bengal, March 30, 1887.

Establishment—General,

Mr. L. R. Roberts, Inspector of Local Works, in the Burdwan Division, is granted furlough, for eight months, from the 22nd proximo.

Mr. A. E. Silk, Assistant Engineer, First Grade, sub. *pro tem*, is confirmed in that grade with effect from the 6th of August 1886.

Baboo Krith Chunder Chowdry, Executive Engineer, Fourth Grade, sub. *pro tem*, (on leave), reverted to Assisistant Engineer, First Grade, on the 1st of September 1886.

Mr. T. Beatty, Executive Engineer, Second Grade, and Divisional Superintendent of Works, Rajshahye, is promoted to Executive Engineer, First Grade, with effect from the 25th September 1886.

Mr. T. M. L. Thompson, Executive Engineer, Fourth Grade sub. *pro tem.*, is confirmed in that grade, with effect from the 26th September 1886.

Mr. H. O. Walling, Assistant Engineer, First Grade, sub. *pro tem* is confirmed in that grade, with effect from the 17th of August 1886.

Mr. H. E. Pellereau, Assistant Engineer, Second Grade, is promoted to Assistant-Engineer, First Grade with effect, from the 28th of September 1886.

Mr. W. B. Bestic, Executive Engineer. Fourth Grade, temporary rank, and Under-Secretary to Government, in the Public Works Department, is promoted to Executive Engineer, Fourth Grade, sub. *pro tem.*, with effect fron the 17th of November 1886.

Mr. A. Hayes, Executive Engineer, Third Grade, sub. *pro tem.*, is confirmed in that grade, with effect from the 1st of January 1887.

Mr. J. R. Swinden, Executive Engineer, Fourth Grade, sub. *pro tem.*, is confirmed in that grade, with effect from the 1st January 1887.

Mr. J. A. Devenish, Assistant Engineer, First Grade, sub. *pro tem.*, is confirmed in that grade, with effect from the 1st of January 1887.

Under the powers vested in him by section 123 of Bengal Local Self-Government Act of 1885, the Lieutenat-Governor is pleased to make the following appointments to have effect from the 1st of April 1887 :—

Mr. H. Joll to be Inspector of Local Works in the Patna Division.

Mr. W. H. Nightingale to be Inspector of Local Works in the Bhagulpore Division.

Mr. T. Beatty to be Inspector of Local Works in the Rajshahye Division.

Mr. J. W. Johnson (on furlough) to be Inspector of Local Works in the Dacca Division.

Establishment-Irrigation.

Mr. C. E. Livesay, Executive Engineer, Second Grade, Nuddea Rivers Division, is granted privilege leave for three months, with effect from the 1st April 1887.

Mr. D. B. Horn, Executive Engineer of the Buxar Division, is granted privilege leave for three months from the 13th proximo, or such date as he may avail himself of it.

Mr. J. R. Swinden, Executive Engineer, Fourth Grade, sub. *pro tem*, attached to the Buxar Division, is appointed to hold charge of that Division during the absence, on privilege leave, of Mr. D. B. Horn, or uutil further orders.

With reference to Bengal Government Notification of the 1st instant, Mr. C. J. L. Middleton, Executive Engineer, Fourth Grade, sub. *pro tem.*, is posted to the Pooree Division, which he joined on the forenoon of the 15th instant.

Punjab, March 24, 1887.

Mr. A. Grant, Assistant Engineer, 1st grade, attached to the Kohat Division, North-West Frontier Road, is allowed leave, on m. c., from the 25th December 1886 to the 15th January 1887.

Mr. J. M. Taylor, Assistant Engineer, 1st grade, sub. *pro tem.* the Patiala-Bhatinda Railway Survey, which he joined on the forenoon of the 10th March 1887.

Mr. A. Grant, Executive. Engineer, 3rd grade, to the Murree and Kohala Road, and received charge of the Road on the 26th February.

Mr. A. E. Orr, Assistant Engineer, 2nd grade, to the Rawul Pindi Provincial Division, which he joined on the afternoon of the 23rd February.

Mr. T. E. Ivens, Executive Engineer, 1st grade, to the Peshawur Provincial Division, Mr. Ivens took over charge of the Division on the 25th idem.

Lieutenant H. C. I. Birdwood, R.E., temporary Assistant Engineer, 2nd grade, is posted to the Dera Ghazi Khan Division, which he joined on the 9th March 1887.

Mr. W. E. Muntz, Assistant Engineer, 2nd grade, is transferred to Burmah for employment on Provincial Works.

Notices.

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CONTENTS.

Answers to Correspondents.

AN OVERSEER complains that subordinates, particularly *natives*, are not treated as liberally in the matter of "Leave" as Engineers, and are subjected to hard treatment generally.

INDIAN ENGINEERING.

SATURDAY, APRIL 9, 1887.

GOVERNMENT LOANS TO MUNICIPALITIES.

THE expansion of local self-government in India has brought in its train cares and responsibilities which it would be idle to ignore. The demand for sanitary improvements and for works of public usefulness has forced itself upon communities entrusted with the management of their own affairs, and they could no longer be postponed to the distant future. If the Press in this country is at all an index of public opinion, water-supply, drainage, reclamation, nay, even town halls and places of social meetings, are all the rage now. With the spread of education among the people they have learnt to appreciate the advantages of such undertakings, and to recognise the fact that if they at all desire to materially increase the average duration of human life, they must be prepared to make large pecuniary sacrifices for the attainment of that object.

In England the authorities have, within a comparatively short period, borrowed more than 160 millions sterling, mainly for sanitary purposes, and are "adding to that debt at a ratio which ranges between eight and fifteen millions per annum." Taking Calcutta as a criterion in this respect, it is estimated that for the next few years a very large capital will have to be raised for its requirements, if the cry for sanitation does not end in smoke. Twenty lakhs will have to be provided for its water scheme, "seven lakhs for *bustee* reclamation and other like improvements, fifty to seventy lakhs might, it is reckoned, be profitably laid out in cutting new roads through crowded localities and disposing of the improved frontage. The total further capital requirements of the city cannot be put much below a crore of rupees." With the amalgamation of the Suburbs, which is to be carried out in the next cold weather, probably a similar outlay will be necessary for cleansing the Augean stables of the 24-Pergunnahs, the home of cholera and other fell diseases that hang like an incubus over the City itself owing to its close proximity.

The question of questions, however, is how are the sinews or war to be provided for these schemes, be they large or small, and it is beginning to exercise the minds of ratepayers and their representatives who clamour for their adjuncts of a civilized life. Up to 1879 a law existed that the Municipalities need not go into the open market for loans, as Government was prepared to be their lender, on condition that the loan was needful and expedient and that their funds were in a state of solvency. As the advance was made on the securities of rates and properties, Government could at any moment, on the interest and capital being left in arrears, assert its rights and enter into possession of the properties mortgaged, with the object of liquidating its claim, just as in an ordinary contract between private parties. But in that year a change came over the deliberations of our Councillors, and the policy hitherto pursued had to be numbered with the institutions of the past. In the Budget Resolution it was observed that the sums thus disposed of were considerable

and the Municipalities should raise their own loans independent of official assistance. The reason is not far to seek. Government was anxious to be relieved of financial embarassments, and as this business would add to its indebtedness, the best way of getting over the difficulty was to ask each Municipality to bear its own burden.

With this new departure from the usual course, the troubles of the local bodies commenced. Their position will best appear by referring to the speech of Sir Theodore Hope, who was in charge of the Bill to amend the Local Authorities Loan Act, 1879. He said that before the new Act could take effect anywhere, a further special enactment would be required, such enactment would, in the case of Local Governments possessing them, be one to be passed by their own legislatures, if they should think it necessary, but in the case of other Governments which did not possess such legislatures, any enactment that might be required would have to be passed in the Imperial Legislative Council. The gist of the Act however was thus explained by the mover:—"Throughout India," he said, "a very large number of small railway branches are wanted to our great lines, and the need of this is being constantly pressed upon us by local authorities, commercial, administrative and others with great urgency At the same time it is quite obvious that we cannot out of Imperial funds construct such branches, or give. guarantees to companies to construct them. If such branches are to be constructed at all, the funds or guarantees must be found in some way totally distinct from those of the Imperial Government, in fact, from sources which lie to hand in the local and municipal revenues of India. At the same time it will be an exceedingly good test of the real necessity of any such branches that such local boards or bodies should have to bear the burden of their construction, and I think we shall thereby obtain an additional safeguard that money will not be thoughtlessly thrown away."

We have advisedly given the above excerpt from the speech of Sir Theodore Hope, inasmuch as on the face of it nothing could be a fairer test of the urgency of the works required, or of the capabilities of local bodies to manage their own affairs with efficiency, and thus prove their claim to self-government. Instead of being in the leading strings of Government they are in future to have to put their own shoulders to the wheel, and with the co-operation of public-spirited and wealthy members of the community be in a position to float any scheme for the improvement of the locality which the general sense of the rate-payers may approve. But is it so in fact, and does past experience teach us that the time has arrived when such bodies could act independently of Government and the withdrawal of all help in the matter of raising loans? A consideration of the subject will be resumed in a future issue.

The firm of Messrs. Parelli, in Genoa, has just secured a contract from the Minister of Public Works to lay a telegraphic cable between Massowah, Assab, and Perim. It must be laid in the space of two months, under a heavy penalty in the event of non-fulfilment of the stipulated condition.

HOW CONTRACTS FOR PUBLIC WORKS ARE MADE IN CHINA.

In view of the persistent importunities of foreigners desiring to improve their commercial relations with the Chinese, and the sharp competition between the different nationalities, it would be strange if the Imperial officials, who have orders to give out, did not take advantage of their position to buy as cheaply as possible.

Europeans or Americans would not be slow to do this under similar circumstances, and they cannot wonder that their Mongolian friends who, though behindhand in some respects, are certainly not so in craftiness, should do the same whenever they have the chance.

But the Chinese appear to do something more than this. They "out-herod Herod." They do on behalf of their Government, which we believe is recognised as a respectable one, things which would in Europe be considered "shady," if done even by a second or third-rate private firm.

This is what has recently happened at Port Arthur, (or Lui Shun Kow,) a port situated at the entrance to the Gulf of Pechili on which is situated the city of Tientsin, and not far from which is the metropolis of Pekin.

It was decided some seven years since that Port Arthur was the proper place for the construction of a dock, the first one, indeed worthy of the name which the Chinese have ever yet undertaken to provide themselves with. The dock was to be mainly for the accommodation of the Imperial Chinese navy, and therefore it must necessarily be deep enough to admit of very large vessels. It must also be sufficiently defended from external attack, and must be provided with workshops, magazines, and all customary appliances. A M. Von Hannekin, a German Engineer, was chosen to direct the work; and under his management a good deal of it was soon successfully carried out. As regards the Harbour works, however, the Chinese seem from the first to have kept the construction of these in their own hands. They entrusted the making of a dam to one Hwang Taoutai, who undertook to do it for 6,000 taels. He made it of mud which did not answer and before it was finally accomplished in some other way it had cost 30,000 taels. Hwang was got rid of. His successor Yuen Taoutai employed some Chinese contractors, who did very well as regards excavating work, but whose retaining walls began to slip all ways as soon as they were built. This experience sickened the authorities of native engineering, and they determined to consult a competent German Engineer. He revised the original plans, and in consultation with his employers. made new ones for the embankments of the Eastern basin, the sheds and the workshops. New contracts were entered into, and all was arranged for proceeding under the direction of the Engineer referred to. But just at that time a French syndicate represented by M. Thèvenet appeared at Tientsin. The Chinese naval authorities took it into their heads to submit the plans of the German to the Frenchman. The latter, as might have been expected, reported unfavorably of his rival's scheme, and offered to make plans of his own and tender for the execution of the

work. At the suggestion of the Commissioner of Customs (a foreigner) the French plans were then submitted to the German Engineer, who pointed out several serious errors. The authorities were puzzled to know what to do, as they had themselves no knowledge to enable them to decide between the contending parties. So they called in an experienced English Engineer. After careful examination, he thoroughly endorsed the German scheme, which he said embodied the best European practice of the day. In the French scheme he showed that there were several errors of judgment of a most glaring kind.

The English Engineer was then requested to make a tender for doing the works on the German plans which he had approved, and this he eventually did; the price quoted being 1,300,000 taels.

The plans and tenders being given up to the authorities for their consideration were immediately handed over by them to the French syndicate with a request that they would make a lower offer. This they eagerly did, 1,150,000 taels being their amended price, on condition no further showing to competitors should take place. This was given (and here they showed great cunning.)

The Chinese having got all they could, readily agreed, and the Frenchmen got the contract, on plans which their competitors had made and they themselves had condemned! In one respect, however, the French tender was quite original. It stipulated that there should be no supervision over their work, except by the Taoutais themselves. The English Engineer on the contrary had stipulated that all his work should be subjected to the inspection of a fully qualified Engineer as is always usual in Europe.

So ends this curious story of a contract with the Chinese.

THE RELATIVE VALUE OF THE INSTRUCTION GIVEN IN THE INDIAN ENGINEERING COLLEGES.

In our issue of the 26th March we furnished a "note" giving the results of the recent examinations for both Collage Diplomas and University Degrees in Engineering at Madras. It will be seen that of the eight students who qualified for the certificate of Assistant Engineer four possessed the University degree of B. A., and of the six who obtained the degree of Bachelor of Civil Engineering four were also Graduates in Arts. Moreover, the First in Arts Examination is an indispensable qualification for entrance into the Engineer Department of the Madras College of Engineering, and even with it the candidates for admission are subjected to a still further test in a competitive examination, from which the successful candidates are selected in order of merit to fill the vacancies in the junior class.

Under these facts we were not a little surprised on reading in the last Annual Report of the Director of Public Instruction in Bengal these remarks on the question of maintaining University control over the Seebpore Engineering College. Sir A. Croft says :—

The University is of necessity a slow-moving body, and on that and other grounds, both the authorities of the College and its critics would probably be glad to see it dissociated from University control; *the certificates being awarded to successful students by the Principal after a College examination, as I understand is the practice at Madras.* There is no doubt that in this way the course of study could be modified from time to time with perfect ease, as circumstances might require; the course would become more elastic; and further, there would cease to be any ground for the complaint of arbitrary and fluctuating tests being applied to, the students. Still, its connexion with the University gives a recognised position to the College and the students trained in it, and at any rate it secures the course of study from violent or unnecessary changes.

Neither the Poona nor the Madras College is "dissociated from University control," and we cannot see why the severance should be made in Calcutta. Roorkee it is true is outside "University regulations," but the circumstances of its foundation and constitution are exceptional. It is, we are aware, affiliated to the Calcutta University, but this is only a nominal connection. As far as we can see, the remarks of the Director are intended to imply that in the Madras College a Certificate of Qualification in Engineering may be obtained by those who complete the prescribed curriculum in Engineering by passing the College Final Examination, and that the same rule does not hold at Seebpore. But this is only an apparent hardship as far as the latter institution is concerned. Its standard of admission is comparatively low, being only the Entrance Examination of the Calcutta University, which enables the student to become a "*Licentiate* of Engineering," which is not possible in Madras, where the University confers no License but a *Degree* which is looked upon in the light of a "Honour" to the College "Pass." The Poona College of Science, which is the Engineering School of Western India, course is, we believe, somewhat similar to that of Seebpore, and, therefore, we think, that a comparison should be made with Bombay and not Madras.

We are disposed, however, to sympathise with the grievance of Seebpore regarding "the capricious character of the University examinations, and the arbitrary and uncertain nature of their results. It is alleged that a class will, year after year, with a series of different examiners, pass well and creditably in a certain subject; and then, suddenly, a new examiner being appointed, the same class of pupils, having received the same preliminary training, and having been taught for the same time by the same professors, will all, or nearly all, be plucked in that subject."

For this there is no remedy, unless it raises its admission test and adopts its own "Pass" examination like Roorkee and Madras and gets Government to similarly recognize the Diplomas thus conferred. In this case, the admirable system of appointing a standing Board of Examiners, to secure uniformity, as in Madras, might be followed with advantage at Seebpore.

Notes and Comments.

ENGINEERING SCHOLARSHIPS.—The Mysore Government offer two vacant Engineering Scholarships of Rs. 25 a month each, tenable at Poona or Madras for the period necessary to qualify for a degree in Engineering, to natives, but preference will be given to Graduates in Arts from the Mysore country.

STONE CARVING *PAR EXCELLENCE*.—No one who has visited the great Mosque at Adoni in the Bellary district of the Madras Presidency can forget the ponderous chain hanging from a corner of its front, each link of which is formed of stone. The art must have attained wondrous perfection here, it being difficult to realise how the links could have been got one into another, so as to form a chain which was to stretch across.

FRONTIER RAILWAYS GUP.—A correspondent writes :—We had General Chesney up this way a few days ago on his way to Quetta. The Duke and Duchess of Connaught left *viâ* the S. P. line on the 27th March. The D. G. R., Mr. Molesworth, and Mr. Williams (Accounts Branch) are sitting in Committee on the S. P. line at Quetta. Nothing has transpired, however, as to what they are investigating in particular.

INDIAN RAILWAYS AS AN INVESTMENT.—Mr. Holt Hallett, in his lecture on Indian railway construction, shows that even with the loss of exchange, the Indian railways—half of which were not in existence in 1874, and one-fourth not in 1880, and many of which are yet far from completed—are already paying only 0·1 per cent. less interest than those of the United States, which have earned the highest average dividend in the world.

THE VICEROY AT THE GUNDUCK BRIDGE.—On the occasion of the ceremonial opening of the Railway Bridge over the River Gunduck His Excellency the Viceroy declared that, among the many benefits conferred on India by British rule, few will be able to compare with those great arterial lines of communication which, during the currency of Her Majesty's reign, have been laid down from one end of the Peninsula to the other, because, after all, it is the public at large, the great masses of the Indian people, whose interests, both personal and commercial, are subserved by these undertakings.

ROORKEE FINAL EXAMINATION.—For the second time, we think, in the history of the Thomason College, a native heads the List, but with 69 per cent. of marks, and only one subject prize, that for Drawing. We observe that the Engineering Design, Mathematics, Civil Engineering, Surveying, and Experimental Science Prizes are taken by different students, while the Photography Prize is taken by Schöeneman, who obtains the Surveying Prize, and stands second on the List with 65 per cent. of marks, being tied with Bhupat Rai, a native student, who carries off the Cautley Medal for Mathematics.

THE BANGALORE WATER-SUPPLY.—The calamity of a scarcity of water is ever recurring in this the second City of Southern India, and the only radical remedy is that suggested by Colonel Mullins—*viz., Distillation.* He says that water of unexceptionable quality is probably obtained at Bangalore only by distillation. It has been ascertained that the best known apparatus for this purpose is the Normandy Company's condenser, which is that recently introduced for the Government water-supply at Aden. The Normandy condenser produces pure, cold, palatable and well ærated water.

BENIGHTED—BEYOND DOUBT!—The Municipal area of the City of Madras spreads now over an area of 27 square miles, and the value of the engineering works to be *maintained* within said limits exceeds 2½ lakhs of rupees per annum. Still some of the Commissioners appear to think that the only *one* Assistant Engineer is one too much. We agree with Mr. Jones (the Municipal Engineer) that the truest economy would be to increase his staff; that, instead of taking away the Assistant Engineer, the interests of the Commissioners would be more economically served by appointing an additional Assistant Engineer.

BOYCE'S AUTOMATIC SAFETY COVERING.—We are aware of many devices protective of goods conveyed in open trucks and cargo boats during the inclement weather in tropical and other countries, but none that enjoys the advantages claimed for "Boyce's Automatic Safety Covering." While combining economy with efficiency it possesses arrangement of parts so simple and at the same time so effective that we have no hesitation in pronouncing it the best of its kind we have yet seen. To railway companies here and elsewhere and cargo boat owners this invention would be found invaluable, as, apart from the safety ensurable to goods and cargo under the arrangement and other economical considerations, the claim for damages against owners and companies arising from less efficient or defective conditions would he reduced to *nil.*

DEHRA DUN RAILWAY.—Mr. E. L. Hunt, Executive Engineer, has submitted his reports, plans and estimates to the Local Government, and takes 18 months' furlough from the 9th April. It is believed thathe has reported in favour of the line surveyed in 1884 by the local promoters, with amendments chiefly suggested by them, as against the alternative routes which he was directed by Government to examine. He has prepared complete estimates of the cost of both lines, and it is hoped that his revision of the promoters' estimate of their proposed line will not show much excess over their figure, although it was from distrust of the privately prepared estimate that the Local Government, at the request of the Government of India, undertook to prepare a fresh project. Mr. Hunt was not called upon to deal with the questions of probable revenue and working expenses, and the battle regarding the latter remains to be fought out.

TOWN REFUSE.—Dr. Hampshire, of Penang, has raised the question of the advisability of utilising town refuse for raising low-lying land, a system which, under certain conditions, lies open to objection. The subject is one of pressing importance in many large towns in the East, and the inexpensiveness of this method of reclaiming marshy ground and filling in low-lying land forms a strong recommendation in its favour, when sanitary reasons are duly borne in mind especially as carried out in the tropics. The worst nuisance arising from this system of disposing of town refuse seems to be flies. These pests, however, only act as a temporary inconvenience, and can be kept within due bounds by adequate arrangements readily admitting of remedying it when once judiciously applied. The harmlessness of *this* system of utilising town refuse, however, wholly depends upon the burning operations, which are an essential feature of Dr. Hampshire's proposal.

THE MADRAS RAILWAY ENGINEERING STAFF.—The Committee appointed by the Directors of the Madras Railway and by the State to inquire into the working of the Company's Indian Administration, in view to reduc-

tion in expenditure being carried out, have almost completed their labours. So far as the Committee are concerned, it is whispered that they have already come to a decision that under no circumstances could the numerical strength of the Engineering staff of the Madras Railway be reduced; for, as it stands, the provision for contingencies, such as illness, departure of officers on leave, &c., is scarcely adequate. As to curtailment of salaries in this branch of the Executive, it is opined that such reduction of salary would only drive away some of its best men, and deprive the Company of the ability and experience absolutely necessary for the maintenance of such a large undertaking as the Madras Railway and the execution of large and important works connected therewith.

The Commercial Union Assurance Company, Limited.—The twenty-fifth annual report of the above Company states that from the profits of the Fire Department the sum of £20,000 has been carried to profit and loss, and that, after providing for outstanding losses, the Fire Fund stood at £581,059, as against £563,070 at the same time last year. In the Life Department the new business consisted of 563 policies, assuring £411,920, and the new premiums amounted to £13,844. The fifth quinquennial valuation, with a view to the distribution of profits, will be made at the close of the present year. From the profits of the Marine Department the sum of £30,000 has been carried to profit and loss, and after providing for outstanding losses the Marine Fund stood at £252,754. The profit and loss account has been closed with a balance of £49,336, carried forward, and out of that amount the Directors recommend the payment of a dividend at 15 per cent. (free of income-tax) making 20 per cent. for the year inclusive of the interim dividend paid in September last.

The Bengal-Nagpur Railway Chief Engineership.—Having already informed our readers that the selection about to be made would be a surprise to many, we are disposed to believe that the *Pioneer's* announcement that Mr. T. R. Wynne is to be Chief of the Nagpur-Bengal Line has some foundation. But the appointment is one of the most injudicious jobs we have seen for a long time. Mr. Wynne is a Cooper's Hill man, aged 34, with only 10 years' experience in the Profession and an Executive Engineer, 3rd grade! He has done much in carrying out other men's designs to order, but beyond this he is absolutely untried. Is this the result of a 4 per cent. guarantee? It would seem that the Directors expect no more and have thus allowed an anomaly. Mr. Wynne has been for the last 2 years at home studying *law*, which, together with the management of a theatrical company in his leisure hours, is not quite the line to fit him for such a post. We have no end of men now waiting for new work, and this line absorbs what would have given three good changes for our spare Superintending Engineers and Executive Engineers.

Testing the Gunduck Bridge.—The Gunduck Bridge was duly tested by Mr. W. H. Bennet, Deputy Consulting Engineer to the Government of India, with the aid and in the presence of many of the Tirhoot State Railway Engineers, on the 25th March. The result of these tests has been most satisfactory to all concerned. The maximum deflection of any of the girders, when under a load of three of the heaviest metre-gauge engines and ten loaded waggons, was one-and-a-quarter inches, and the maximum oscillation of the top boom, when the above train was passing over the girders at a speed of 20 miles an hour, was five-eighths of an inch. One very noticeable feature in the testing was the use of water as a means of noting the deflection. A gaspipe was laid the whole length of the bridge on both sides, connected to tanks at the east abutment and fitted with stand pipes and gauge glasses at the two points on each girder. The level of the water in the gauge glasses was read on a scale attached to them, both before and at the time when the full weight of the train was bearing on the span. The use of levels, however, was found necessary for the speed test, as the movement of the train set up a wave motion in the water which made the readings untrustworthy.

The Bolan Railway.—The Bolan Railway has been opened for goods traffic to Quetta, but the opening for passengers has been delayed owing to insufficient passenger rolling-stock on the metre gauge section. It is also intended to fix vacuum brakes on all passenger vehicles. This is a most necessary precaution. An accident took place on the 29th March last that would never have happened had these brakes been in use. Two trucks were cut off a ballast train in a station, through siding on the metre gauge line which is on a grade of 1 in 30, while the engine was required to water. The "sprags" to fasten the wheels were either not used on this occasion or slipped out and the wagons got away. The engine was in the way and the driver seeing the wagons coming at him ran away from them, hoping to gradually stop them by coupling on while in motion and using the engine brakes. A very high speed, however, was got up before this could be done and a derailment occurred near a catch siding, resulting in rather a bad accident. It is needless to state that had either the Westinghouse or vacuum brake been in use this would not have occurred. The train which took up the Duke and Duchess of Connaught was provided with the latter, and previous to taking them up was tried with the utmost success. Perhaps they will be speedily adopted now for ordinary use.

The Great Railway Engineering Feat.—Some of our readers, who read the remarks of the *Pioneer* on the bridge which has lately been opened at Chupper on the Sind-Pishin Railway, will be surprised to learn that the bridge consists merely of one span of 150 feet and seven spans of 40 feet girders, and is thus under 500 feet in length. The foundations were dry and exceptionally easy, as rock is found directly on the surface. As to the height, we believe one of the piers is somewhat more than sixty feet high, but the other piers and both abutments are very much less in height. Some difficulty would no doubt be experienced in lifting the 150 feet girders, as the nullah in the centre of the large span is at a great depth, some 250 feet below girder bed level. The launching of a girder of this size, however, though no doubt requiring much care and forethought, can hardly be considered an operation of great magnitude. We do not wish to underrate the bridge. The work is no doubt one of considerable importance, but the phrases "skilful piece of engineering" and "greatest railway engineering feat" which meet one's eye in the *Pioneer's* article are quite out of place and applicable neither to the bridge nor to the Sind-Pishin Railway. The truth is that there are no great engineering feats on the Sind-Pishin Railway. The work is very heavy throughout, but there is no really long tunnel or even one of those large bridges (of half a mile in length and upwards) which are found on nearly every Indian railway.

Current News.

MR. FRANKLIN PRESTAGE, Chairman of the D. H. R., has returned to Darjeeling after a short tour in Ceylon.

THE replacement of the girders of the Choral Bridge, No. 3, between Mhow and Kalakoond, was completed on the 28th March.

IT is understood that, by the end of the present financial year, the Hooghly Bridge will be free from debt and have paid for itself.

THE last *Bombay Government Gazette* contains a valedictory notice of Lieutenant-General W. W. Goodfellow's services, on his retirement.

THE report of the Managing Agents of the Baragunda Copper Company for the year 1886 is considered by some as generally discouraging.

THERE is no Government order whatever against any of its servants being connected with a literary publication; nor indeed with any other publication.

A MOVEMENT is on foot for the construction of 240 miles of railway necessary to connect Pali, on the Rajputana State Railway, with Hyderabad in Sind, *viâ* Umarkot.

THE project of the spinning and weaving mills, which Messrs. Tata and Company of Bombay proposed to establish at Pondicherry, have been given up for the present.

INFORMATION coming by way of Afghanistan states that the section of the Russian Trans-Caspian Railway from Charjui on the Oxus to Bokhara is nearly complete.

THE farewell dinner to Colonel S. T. Trevor will be held at the Town Hall, Calcutta, on this (Saturday) evening, Mr. Horace Bell presiding. About eighty gentlemen will be present.

THE Maisur Government has informed those who are interested in gold mining that the royalty payable is to be on the nett sale proceeds, and not on the cost of producing the gold.

MR. H. B. H. TURNER (Messrs. Turner, Morrison and Co.) has been elected President of the Bengal Chamber of Commerce in the place of the Honourable D. Cruickshank proceeded to England.

THE last *Madras Gazette* announces the appointment of Mr. Walter Keess, M.A., M.R.A.C., as acting Principal of the College of Agriculture, during the absence of Mr. Robertson on leave or until further orders.

THE extension of the Dacca State Railway to Chittagong has been sanctioned. This is one of the new lines which Sir Theodore Hope wishes to see placed in a fair way for commencement before he leaves office.

COLONEL PENNYCUICK, R.E., Superintending Engineer, Madras, has been appointed Examiner for the year 1887 in Public Works Practice and Procedure, and it has been decided that the Examination shall be held on 30th July.

THE cause of the recent accident in the Mysore section of the Southern Mahratta Railway has, upon investigation, been found to have been the breaking of the gudgeon pin, in consequence of which the small end rod slipped out, caught the rails and derailed both the engine and wagons.

A LITTLE Railway Conference was held in Allahabad on the 30th March to settle the details of the junction of the East Indian, Indian Midland, and Oudh and Rohilkhund lines at Cawnpore; the direct approach for the Oudh trains to the East Indian station there; and the junction of the Oudh and Rohilkhund line with the East Indian at Mogul Serai, in connection with the opening of the Benares Bridge.

THE Mandalay Railway is now laid for about twenty miles beyond Toungboo, not on the embankment, but on the service road. This is done to allow the embankment to consolidate during the approaching wet season. After the rains are over the embankment will be dressed and ballasted, and the line will then be taken up and relaid on it. The earthwork is making progress from both the Tounghoo and Mandalay ends, and also the platelaying, such as it is. The climate is much hotter than that of Bengal, the pay of Europeans is much smaller, and their expenses are much heavier.

THE *Railway* Conference held in Allahabad last week agreed that as regards goods traffic generally the Indian Midland trains will run to the Oudh and Rohilkhund station at Cawnpore; but passengers and goods for and from stations on the East Indian line will go to the East Indian station. The Indian Midland Company, therefore, will not have a separate station at Cawnpore. The Rajputana-Malwa line may possibly have similar junction arrangements. The branch line from Mogul Serai to the Ganges Bridge at Benares will ultimately be transferred by the East Indian Railway to Government and by the latter to the Oudh and Rohilkhund Company, but the E. I. R. will, of course, retain and work the Mogul Serai junction on the main line.

THE last number of INDIAN ENGINEERING contains a likeness of Sir Bradford Leslie, intended as a parting tribute to that distinguished Engineer. It gives also an illustration of the public offices at Jodhpore showing a façade nearly 1,000 feet in length in characteristics of the best style of Indian architecture. We observe that the Journal is increasing in size and are glad to find the quality of reading matter is equal to the high standard of its early numbers.—*Statesman*, March 5.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

RIVER PROTECTION WORKS.

SIR,—I should be very glad if any of your readers would kindly give me the benefit of their experience in River Protection Works under the following circumstances. We shall require to put up strong protections round excavations in the bed of the Kurram where the writer is erecting a Bridge the foundations of which are to be 30ft. below lowest bed. The excavations are in small boulders and sand and are quite dry strange to say. The Kurram river has a fall of 23ft. in a mile and comes down in very violent floods from May to August; the boulders found are very small, not over one foot in diameter, the great majority being far less. I want to know the best and cheapest form of Bund to withstand such a current, the ordinary bunds of stone and branches are it is said swept away at once. I should be glad also to have opinions as to the angle they should be run out from the bank. Engineers with whom I have talked say at right angles; I think not quite so much. I should be much obliged to any Correspondent who having had experience of such a river would give me the benefit of it.

FITZHUGH COX,

Bannu, March 25. *Ex. Engineer, Bridges Division.*

"SERVICE GRIEVANCES."

SIR,—In your issue of the 19th March I see you take exception to the appointments of Captain B. Scott and Major Gracey, R. E's., but omit to say anything regarding Mr. C. Swappe, C.E., who has been permitted to take furlough and spend it in serving the I. M. Railway Company. I presume furlough is granted by Government to their officers to enable them to recruit their health which is supposed to have suffered from the arduous duties undergone in a trying climate; and it is a perversion of the privilege to spend this leave in the same place and doing the same duties with the object of drawing double pay. On investigation it will be found appointments such as those first mentioned are prize posts given in recognition of some claim (real or fancied) for good work done. No reason, however, can be brought to justify the latter being permitted, while it is a gross injustice to the large body of outsiders who suffer from want of work and promotion through it. It will be seen that it does not require the addition of "certain cabalistic letters after their names" to get hold of these posts. In fact, it is the C. E's. in the D. P. W. who have grabbed the most in this line, and while they show a keen appreciation of grievances and jobbery where it affects themselves are the foremost to transgress where they are the gainers.

R. S.

GARSON'S PATENT SUSPENSION BRIDGES.

SIR,—Though my reply to your correspondent "X" covers some of the ground touched upon by "F (x)" in your issue of March 26th, yet the subject is such an important one that I will give further particulars as to the admissible strains in pin joints.

No wonder they are not in favor with English Engineers, if designed upon the principles enunciated by your two correspondents.

It is to the most modern practice, rather than the records of that respectable body, the Royal Society, that we should look for reliable data, and to America rather than England, for every bridge of any size in the former country is pin connected and American Engineers show no signs of abandoning the system. Only they have found out by experience that it is essential to the durability of pin joints that the details should be carefully considered, both as to bearing area and bending stresses.

Here is an extract from the standard specification of one of the large Railways, which may be considered to embody the latest views on the subject:—"Bearing stress on rivets and pins shall not exceed 12,000lbs. per square inch, nor shall bending stress exceed 12,000lbs. on top chord pins, and 15,000lbs. on bottom chord pins when the centres of the strained members are taken as the points of application of the loads."

The proportions given in Molesworth are good, but he does not touch upon bending stresses.

Finally, in the best English work, the bearing stress on steel rivets is limited to 6 tons, and as rivetted joints are not so subject to vibration as pins, and have the very considerable addition of the grip of the heads, it is reasonable to fix the limit a little lower for steel pins.

I trust this consensus of modern practice will convince your readers that 7 tons is too much for bearing stress on pins, having a due regard to durability. And the lighter the bridge, the lower should be the stress, as the vibration caused by rolling loads is greater than in large bridges.

F. E. R.

THE ROORKEE FOUNDRY ENGINEERING CO., LD.

SIR,—The Prospectus of this Company was published in London on the 1st March last, the advertisement stating that the subscription Lists would open on Thursday, the 3rd of March, and close on Tuesday, the 8th of March. The Share Capital is to be £80,000 in 16,000 shares of £5 each and the Debenture Capital £50,000 bearing interest at 6 per cent. per annum. In the Prospec-

tus it is stated that the Company has been formed to take over and carry on the valuable and extensive Foundry and Engineering Works at Roorkee in the North-West Provinces of India *which have for many years past been in successful operation under the Public Works Department of the Government of India.* The class of business which has *hitherto* been done by the workshops is the Manufacture of Machinery, Ironwork, Bridges, Canal boats, Dock Gates, and all kind of appliances and utensils. The stock of patterns and apparatus ensures the continuance of support from the already long established connexion with the public *as well as the Government.* The Government valuation in April 1886 showed that the block, plant, stores (priced at the then ruling market rates), London Invoices and Supplies, amounted to Rs. 13,85,079, for which sum at 1s-5½d per rupee or £ 101,000 the vendors have agreed to transfer the undertaking to the Company. The purchase money includes a sum of upwards of nine lakhs of rupees or about £66,000 for stores in the Shops, which enormous quantity has accumulated (in how many years the Prospectus does not show) in consequence of the system of indenting once a year on the Secretary of State for supplies sufficient to meet all possible requirements during the whole year. It is intended to sell off this surplus stock and "no difficulty is anticipated" in doing this. This realisation will form a fund which may be applied for the redemption of the Debentures, or otherwise, from time to time.

The net profits for the 4 years ending March 1885 was, it is stated, Rs. 4,80,000 or an average of Rs. 1,20,000 per annum. Relying on these figures the Directors anticipate that the Works will yield a net annual profit sufficient for the payment of 6 per cent on the Debentures and 9 per cent. on shares.

And as an additional inducement to investors it is added "that the Government of the N.-W. Provinces has promised to give the Company all the assistance in its power."

We can quite understand after reading the Prospectus why the vendors did not try to float the Company in India and also why sufficient time was not given for enquiries to be made.

It all looks very good on paper, but we think the public will be wise if they leave this "good thing" alone, as to any one acquainted with Engineering enterprise in India, it will be patent that the scheme will end in another "Burrakur."

In the first place it is proposed to carry on the business with a working capital of £30,000 or say 4 lakhs of rupees, and this we need not say is utterly insufficient if the work turned out in one year is as large as the Directors anticipate. But we care little for this. What we wish more especially to point out is that the public in general are induced to invest their capital in Indian business without knowing all the facts. To any one behind the scenes the Prospectus carries its own condemnation. The Directors for instance in order to show what a mine of wealth they possess let the public know that the *purchase money includes a sum of upwards of nine lakhs of rupees or about* £66,000 *for stores in the shops*, and gravely tell them that this large quantity of stock has accumulated in consequence of the system of indenting once a year on the Secretary of State for supplies! Of course every one knows, at least every Government Engineer knows, how impossible it is to get any work done by the India Office under 12 to 15 months, and probably before the material arrives in India the building or other work in hand is finished. Other material has been purchased or made up locally and the stores sent out from England are put into stock. How many thousands of tons of iron and stores are now lying all over India owing to this insane policy of indenting on the Secretary of State and what is the value of these accumulations? Would not the Government of India gladly dispose of the old rubbish at less than half the cost? We believe many years ago there were certain depots belonging to the D. P. W. from whence Engineers could obtain their stores. Does anyone know the result of that scheme? Some one could a tale unfold! How much of surplus stores is sold every year by the E. I. R., the State Railways, and the Military Works, and what does it fetch? Scrap prices!—Say one-tenth of the cost. Well, the Roorkee Foundry and Engineering Company possess nine lakhs worth of this material, which it includes in its capital and by the realisation of which it is proposed to pay off the Debentures.

Now, with regard to the future prospects of the concern. The Directors anticipate a profit of at least Rs. 1,20,000 per annum, and base their hopes on the past working of the establishment. It is stated that the net profits for the past 4 years amounted to Rs. 4,80,000 or an average of Rs. 1,20,000 per annum. We were under the impression, and we think the reports of years past would go to prove, that the shops had never paid and that the Government were only too glad to get rid of them. Take the words of Mr. Campbell, the Manager of the Shops:—"I think if these Workshops were in the hands of a private firm they would pay well." What does this imply? Would not any one think Rs. 1,20,000 per annum profit was a good return? We take it that the Manager's report can only imply that the Government was losing by the Workshops and that this was owing to his being handicapped in not getting his materials quickly. We think if the whole of the reports were laid before the public we should not hear so much about these paper profits. We will, however, allow that the profits have been made, that the Workshops have realised a profit of Rs. 1,20,000 per annum. But how? What is the class of business which has hitherto been done by the Workshops? The Prospectus tells, "It is the manufacture of machinery, ironwork, bridges, canal boats, dock gates," nearly the whole of which has been for Government and obtained not by competition with local firms, but work given to them by the various spending departments of the Government for the P. W. D., the Military Works, Railways, &c., for which work they could charge any price the management liked to make. We would ask any officer of the P. W. D. who has had work done at Roorkee if he cannot get the same work done in Bombay or Calcutta at much lower rates and more expeditiously? We hear much of the great desire of Government to withdraw from private enterprise. Why then do they keep up all the petty workshops all over the country,—the small workshops at Peshawur, Rawul Pindi, Meerut, Allahabad, Seebpore, and elsewhere?

But even if Government were to give up all their workshops and transfer them to private firms will they patronise local industry? Can the future Roorkee Co. rely upon the Government of the N.-W. Provinces keeping their promise to give the Company all the assistance in its power? This is not promising much, as we cannot suppose any Government department is going to show any favour, and we presume what is implied is that the Government will give them the same opportunities for tendering for work as is now possessed by other firms in the country. But the Government of India by its recent orders has shown that it has no intention of fostering local industry. Obedient to the wishes of the clique in the India Office, they strictly prohibit Executive Officers from purchasing stores manufactured in England except through the agency of the Secretary of State, and although they may occasionally have iron-work made up in India from imported material such purchases are not to be encouraged and to be permitted only in exceptional cases.

We believe that if the public are induced to put their money in this concern relying upon the statements made in the Prospectus their expectations are not likely to be realized. They are relying upon the Government assurance that a handsome profit has been realised for the last 4 years when in a commercial sense no profit at all has been made, and they are also relying upon the Government giving them a large share of their future business, in which we have shown they must be disappointed. FAIR TRADE.

Literary Notices.

PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS. No 4, 1886.

THIS volume contains only *one* Paper and that is on "Triple-Expansion Marine Engines," by the late Robert Wyllie. The author observes that the last few years may be regarded as a transition period in the history of Marine Engineering, as the high-pressure Triple-Expansion Engine has now proved the successful rival of the double-expansion compound. The object of his Paper is to bring forward the results of experience with this new type of engine, and to consider briefly the various points which have a direct bearing on its efficiency, as well as the most suitable design for marine purposes.

The subject has been already noticed in our "Home Notes," and calls for no special remark in a cursory notice.

JOURNAL OF THE STATISTICAL SOCIETY. December 1887.

THE feature of this the last Part of volume XLIX is Mr. Jean's contribution "On the Cost and the Conditions of Working Railway Traffic in Different Countries." It might well be observed that so much brain work, on the part of the author of "Railway Problems" in addition to his laborious services as Secretary to the Iron and Steel Institute and the British Iron Trade Association, and in other directions, may well puzzle students, and induce admiration of the writer's zeal and energy. The Paper under notice is of extreme public value, and well expresses the problem of how on the one hand to promote inexpensive transportation and on the other to carry out a profitable commercial undertaking. We may revert to this subject on some future occasion, should the pressure on our space diminish.

Mr. Acland's Paper "on Working Men's Co-operative Organisations in Great Britain" is an interesting inquiry into the correctness or otherwise of Walker's view that "Whatever may be true in politics, the industry of the world is not tending towards democracy, but in the opposite direction." In connection with this and allied subjects, we would invite attention to our articles in last and this issue on "The Red Spectre" and "Vital Statistics."

The translation from French of M. Fournier de Flair on "The Increase of Shipping and Dock Accommodation in the Principal Maritime Ports," given in the "Miscellanea," is an article in every way worthy of attention.

General Articles.

THE MADRAS HARBOUR.

Its Construction, Destruction, and Reconstruction.

VI.

In his report Mr. Parkes went fully into the question of "the sand difficulty," which he did not think serious enough to warrant doubts as to the success of his proposed close harbour. During the construction of the work, the difficulty was for sometime serious; but as we have said in a previous article it had, for the time at least, disappeared by January 1879. Writing, however, in November 1879, and reviewing the whole sand question from its commencement to what he then felt justified in calling its termination, Mr. Parkes said :—"My conclusion was from the first, and still is, that supplementary walls will at some future time be required to prevent the advance of sand from destroying the harbour, but that the period at which this will become necessary is so distant that it need not at present be taken into account. To show that this does not impose any serious burden on posterity, I may mention that whatever the length of time may be, it may be *doubled* by the extension of the south pier seaward for a length of 1,000 feet, at a cost of £80,000." This was in answer to proposals which had been made in February 1879 by the Honourable Sir Andrew Clarke, R.E., Member of the Supreme Council, for a radical modification of the design of the harbour which involved the removal of the shore ends of both piers for a considerable distance from the shore, so as to allow free motion of the sand along the coast (see Plate II). Much interesting matter regarding the sand question will be found in the volume under notice, but we cannot give further space to its consideration. Nor can we here discuss the comparative advantages and disadvantages of one entrance, facing east by south, as proposed by Mr. Parkes, and of two entrances, facing north and south, as proposed by other authorities. As Sir Andrew Clarke remarked :—"The whole scheme for a harbour at Madras opens up engineering questions for the solution of which it is very often difficult, if not impossible, to quote precedent." Harbours are generally either formed or suggested by the configuration of a coast, or by the falling into the sea of a river; but at Madras there are no such natural advantages, and had not Madras happened to be there, no one would ever have thought of making a harbour on that part of the coast.

The annexed sketch (A) shows the cross section of the piers in deep water, as they were actually built, except that more rubble appears to have been added so as partly to unbed the lower course of concrete blocks, *vide* the dotted line.

And sketch (B) shows how the blocks were set on edge with a batter, so as to produce friction and make them less easily displaced.

In a report written in February 1879, having found that commanders of steamers would generally prefer a projecting entrance to the harbour to the opening and the straight eastern front as originally designed, as leading the cross current off from acting on the after part of a long ship, while the fore part was in still water and with little way on her, and also because it would give greater space to bring up on without danger of fouling ships at moorings, Mr. Parkes proposed an alteration of the design, which was adopted; and as constructed the two breakwaters curve inwards towards each other, at a distance of 2,500 feet from high water mark on shore, with a curve of 528 feet radius, and then again resume a straight line at an angle of 112° to their former directions, approaching one another until their ends are 550 feet apart. The opening in the straight eastern face as originally designed was only 450 feet in width.

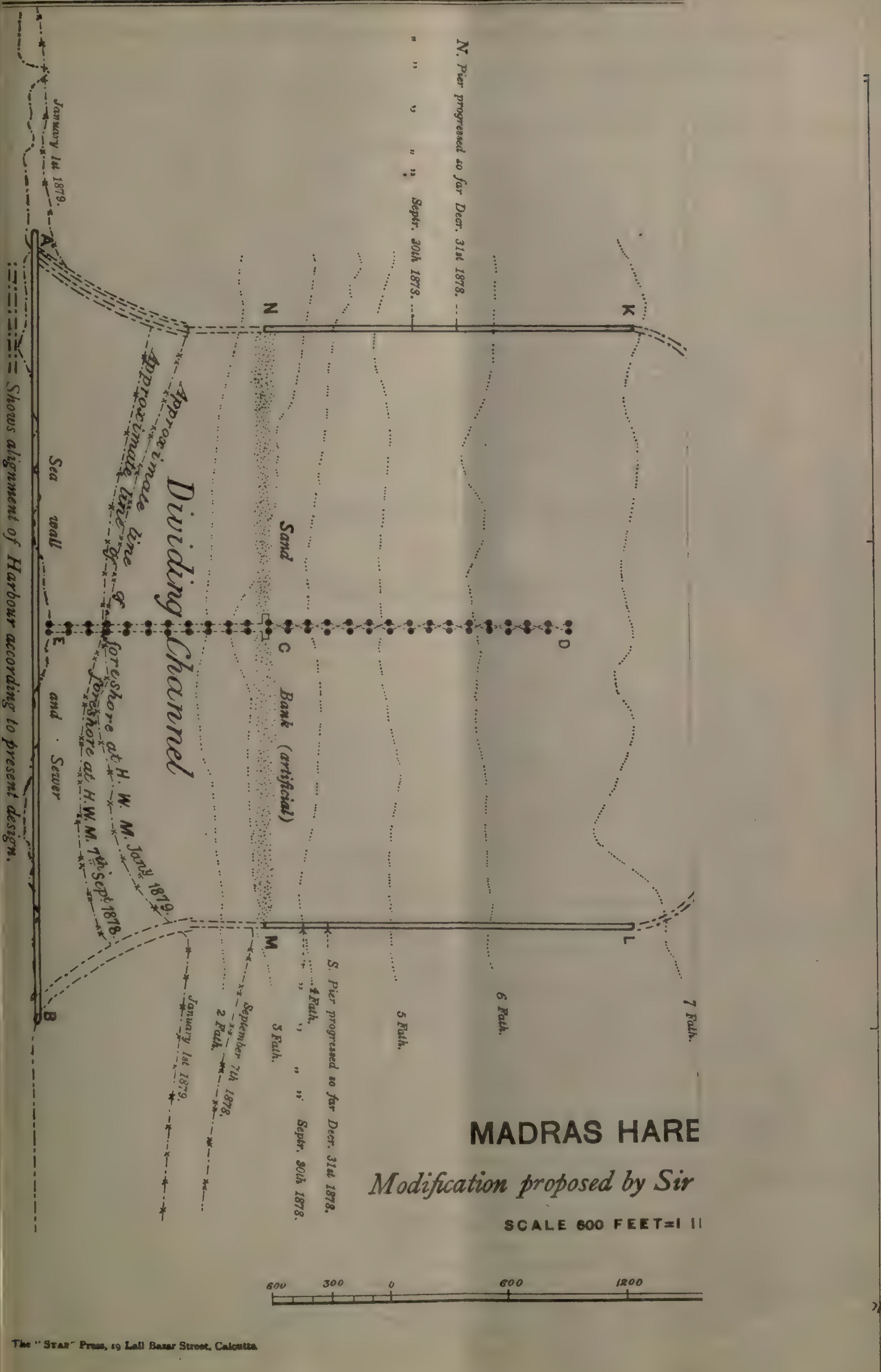
Turning to the sketches above referred to, we find that "the breakwaters are of a design very similar to that of the Manora breakwater, Kurrachee, also designed by Mr. Parkes in 1869. The lower portion of the piers or breakwaters is formed of a bank or base of loose rubble, 79 feet wide at the top, and with 1 to 1 slopes, the top being 22½ feet below mean sea-level. As the work advances into deeper water the rubble base of course becomes higher and wider at the bottom, as, except at the ends of the piers, the level of 22½ feet below mean sea-level is uniform for the top of the base."

With regard to the superstructure of concrete blocks, we find—still quoting from the description of the Superintendent of the Works, Mr. F. N. Thorowgood, Mem. Inst. C. E.—that the "bottom blocks are each 2 feet wider than the courses above, and give a total width of 28 feet to the foundation course, the upper courses having a width of only 24 feet. The bottom blocks weigh 22½ tons and the upper course blocks 27 tons each. One great peculiarity of the design of the Madras piers is the absence of 'bond' between the courses. The 27-ton blocks measure $4' 6'' \times 12' 0'' \times 8' 0''$ and are placed side by side, each resting on the block immediately below, and never resting upon two blocks. The only approach to a fastening between individual blocks consists in the joggles shown in the section. These consist of projections 2 feet wide and 13½ inches high at the high end, which fit into a recess in the block above, the recess being 2 feet 6 inches wide admits of 3 inches play each way before the joggle touches the side of the recess. The piers indeed actually consist of two rows of a series of piles of concrete blocks, each pile composed of four blocks in height, and each capable of settlement without dragging down its contiguous neighbour, the two rows being perfectly independent of each other throughout the whole length of the pier.

"The piles of blocks are not set with a vertical face, but with a batter of 3 inches to 1 foot, so that each course of blocks presses back upon the course behind it, and thus tends, by friction, to prevent displacement. Only the ends of the blocks are exposed to the direct horizontal blows of the sea, and as the end of one 27-ton block gives an area of 36 square feet, and the dead weight at the back of this area is $2 \times 27 = 54$ tons, there must be a force of 1½ ton per square foot to dislodge any one course of blocks in the full width of the pier, supposing the blocks were quite free to move. But to this resistance of dead weight must be added the grip caused by friction against contiguous blocks, *plus* the hold afforded by the joggle into the course of blocks below,* so that it will be safe to believe that a force of 2 tons per square foot would be needed to displace any course of blocks of the completed pier, supposing the force to be simply a blow acting directly on the area of the exposed end of the course."

This calculation of the force required to displace a course of blocks applies, as is apparent, only to a top course; but then if a top course were dislodged it would apply to the next below it, and so on down to the bottom. Scott Russell estimates that a roller 20 feet high may exert a blow of about 1 ton per square foot; but Stevenson has recorded blows of nearly 3 tons per square foot at the Skerryoore lighthouse, and 1½ ton on the Bell Rock; and a year before Mr. Parkes submitted his design for the Madras Harbour a case occurred at Wick, in the north of Scotland, where the head of a pier, consisting of a solid mass of concrete and masonry, 26 feet long, 20 feet high, averaging 46 feet wide, and weighing 1,350 tons, was moved bodily from its position and deposited entire on the rubble inside the pier. If the direction from which this wave struck the pier head was at right angles to the smallest area of the block, the force of the blow must have exceeded 2·6 tons per square foot, but if it struck its end, it may have been 1 ton per foot less. The pier was then restored and a similar monolith placed at its end, of the same length and breadth as the one that had been washed away, but it was secured by bolts to the mass below it, so that the whole mass became virtually a monolith of 2,500

* The joggles were previously described as fitting into recesses in the blocks above.



MADRAS HARB

Modification proposed by Sir

SCALE 600 FEET=1 I

The "Star" Press, 19 Lall Bazar Street, Calcutta.

tons. But this in its turn was carried away. These extraordinary effects of waves on a vertical breakwater were of course known to Mr. Parkes, and, when in 1881 he was invited by the Madras Government to defend the propriety of adopting so small a width as 24 feet for the upper portion of the Madras breakwater, he thus referred to them:—

It will be easily understood that these extraordinary occurrences were matters of deep interest to engineers connected with marine works. When the particulars became known to me the breakwater at Kurrachee, 24 feet wide, had been completed, and those at Madras of the same width had been sanctioned for execution, I carefully reviewed the bases of my own conclusions with this new fact before me, but I soon found that an indiscriminating application of the lesson would condemn, not only these works, but many others which have stood the test of many years' experience, and I ultimately saw no reason to alter my own designs.

An occurrence at Kurrachee which took place six months after the earlier one at Wick added another important fact to our data. It may be remembered that the first few hundred feet of the Manora breakwater suffered repeatedly from the failure of the foundations, which caused the displacement of several blocks. The most serious case of this involved the complete overthrow of the harbour side wall for a length of about 80 feet, leaving the sea side wall, consisting of a single row of blocks, standing 12 feet wide, without any support. This stood perfectly throughout the remainder of the monsoon. This direct proof that 24 feet was more than enough at Kurrachee seemed to outweigh any indirect conclusion from the unprecedented occurrence at Wick.

I should mention that the force of sea at Wick is acknowledged to be most exceptional. A competent observer estimated the height of the waves at 42 feet from hollow to crest. The highest wave measured at Kurrachee was 15 feet. None have been recently measured at Madras, but a former Master Attendant, Captain Biden, estimated the maximum height at 10 feet. The most extreme alarmist therefore could hardly suggest the necessity of adopting the Wick proportions at either of these places.

I may state, however, that the only portions of the Madras work which can be subject to a destructive force similar in kind to that at Wick, though less in degree, are the pier heads. These, for other reasons than stability, will have dimensions considerably in excess of those at Wick. The bodies of the piers themselves will be 45 feet wide, and this width will be further supported by a return towards the shore 75 feet long. It is, therefore, I think, impossible to imagine them liable to any such damage.

The "bodies of the piers" might be 45 feet wide, and be supported by a buttress of 75 feet in length, but Mr. Parkes' monoliths would still be only 27 tons weight each, and he studiously left them totally unbonded and unprotected in any way, except by the joggles, which admitted of the blocks moving 3 inches laterally either way. The "impossibility," which Mr. Parkes was unable to imagine, seems to have been that his pier heads of 120 feet in width should ever be moved bodily as monoliths off his rubble foundation, but he took ample precautions against such an occurrence by building them of small disconnected blocks. Had they been built in a solid mass as the Wick pier heads were, they possibly might not have been washed away.

The "occurrence" at Kurrachee, referred to by Mr. Parkes in the passage above quoted, but one moral of which he seems to have so strangely disregarded, was paralleled to some extent during the construction of the Madras Harbour, and apparently in much deeper water, for in November 1880 a scour occurred of the rubble base of the north pier in 22 feet of water and the end row of blocks dropped into the hole thus formed. Mr. Parkes' report of the 14th January 1881, in which this is mentioned, is not published *in extenso*, but an extract is embodied in another document, and we reproduce it with its accompanying sketch, as showing that Mr. Parkes met the difficulty, not by increasing the size of his rubble or protecting its surface in any way, but by keeping the crest of the rubble base lower below water-mark, and increasing the depth of the concrete superstructure. This Mr. Parkes calls increasing the depth of the foundations of his work, by which he means founding the vertical portion at a greater depth in the water below sea-level; but the weight of the superstructure was thus greatly increased, while the thickness of the foundation of small rubble, on which it rested, and the greater part of which latterly consisted, not of granite or other hard stone, but of soft laterite—which was quarried without the aid of blasting, and in fact dug up with hoes and crowbars—was greatly diminished.

This sea is also especially noteworthy, because by it for the first time have some blocks, fairly set at the proper depth and on a clean rubble foundation, been disturbed, thus affording some direct evidence of the limits of stability of the work. At the north pier the rush of water round the end was so violent as to scoop out a hole in the rubble at the foot of the blocks into which the end blocks dropped down about 3 feet, being at the same time laterally displaced slightly, as shown in sketch C. The iron clamps* by which they were attached to the third row behind them were not broken and that row and the one intermediate between them were not disturbed.

The most obvious effect of the sea on the completed portion of the north pier was to strip off the railway from the top, but this effect only extended for the length built since the last heavy sea in November 1879. In the older portions it was not disturbed. The cause of this difference was apparent on examination of the blocks themselves. They had evidently been subjected to a very severe shaking, for the surfaces were found to be abraded by rubbing against one another to such an extent as in some cases to form indentations 4 inches deep. To produce this result the whole structure must have been in a state of violent vibration, and this would break the connection between the tops of the individual blocks and the contiguous rigid railway laid upon them. When the block work has once been subjected to this vibrating action it becomes consolidated and rigid, and the railways maintain their connection with it. The sea does not appear to have caused any general subsidence.

Reverting to the subsidence of the end blocks, it may be well to point out how this bears on the sufficiency of the design for the permanent pier head. The weak points in the temporary termination are evidently the following:—

1st.—Rubble stone at 22 feet below the surface is not proof against the scour of the wave rushing round the abrupt end of the pier.

2nd.—The abruptness of the end increases the force of the scour.

3rd.—The blocks have a hold of only 4 feet 6 inches, their own thickness in the solid work.

Now, though the exact form of the whole of the permanent pier head is not yet determined, yet some features have long been settled on:—

1st.—The depth of the foundation of the blocks on the rubble will be 28 feet instead of 22.

2nd.—There will be no sharp corners to aggravate the scour, the corners being formed of blocks in the quadrant of a circle 12 feet radius.

3rd.—All the blocks exposed to the end between these curved angle blocks will be set as "headers", with their ends instead of their sides exposed, so as to have a hold in the work of 12 feet instead of 4½ feet.

With these additional elements of stability it is clear that the permanent pier head will be proof against a much heavier sea than the temporary one.

While we write, comes a rumour, so circumstantial that it is probably only too well founded, that the breakwater of the Colombo Harbour, an illustrated account of which we gave in a recent number of this Journal, and which presented a great contrast in cross section and mode of construction to the Madras work, is failing,—*vide* our "Note" on page 175 of last issue. What has happened is not very clear, even with the aid of the drawings, but it appears that the "3½ ton rubble" at Colombo, though it was granite, proved to be sufficiently heavy. What chance then had the quartzose gneiss and laterite at Madras, the size of which varied from 5lbs. crumbs to 2cwts. lumps?

(To be continued.)

* A temporary appliance.—Ed., *I. E.*

Progress in Japan.—The Osaka Glass Factory is engaging 260 additional workmen, and is now producing plate glass to be used in the new Imperial Palace. It is stated that the company is realizing about *yen* 4,500 per month on this work.

The profits of the Osaka Sulphuric Acid Company will admit of a dividend being paid of 10 per cent. on the working for the last six months of 1886. On that of the previous six months, a dividend of 12 per cent. was paid.

The Osaka-Sakai Railway Company has ordered a quantity of rails from England through Mr. Kuwabara, of Messrs. Fujita & Co., who is at present staying in England. The work of extending the present line will be commenced in the beginning of next month.

The Tôkyô Gas Company has declared a dividend of 10 per cent. (*yen* 5 per share), and will reduce the price of gas.

The Osaka Spinning Company has declared a dividend for the half-year of *yen* 8 per share (*yen* 100), an increase of *yen* 3 as compared with the dividend for the first half of 1886.

The Kyôeisha at Tokuyama, Suô, has decided to increase its capital by *yen* 300,000, permission having been obtained from the Government, in order to extend its shipping business.

Sumatra Petroleum.—The petroleum springs known to abound in the district of Langkat, in Sumatra, bid fair to be turned to profitable account ere long for commercial purposes. Mr. Zylker, an enterprising gentleman, who has fully prospected the locality, has entered into an agreement with the Pangerun of Langkat, who has granted him a concession to work the springs. Mr. Zylker has secured the exclusive right to turn them to advantage during 75 years, on payment of a fixed sum of money, dependent on the quantity of oil turned out.

NOTE ON PORTABLE RAILWAYS.

(Continued from page 166.)

BY LT.-COL. S. S. JACOB, EXECUTIVE ENGINEER, JEYPORE.

REGARDING the type of rail and wagon perhaps the following remarks may be useful.

Rails.—The best for haulage by manual labour only is the 16-feet gauge 10lbs. rails, but as it might be necessary to use locomotives, and it is advisable to be prepared for all emergencies in war or famine, I would suggest 2-feet gauge with 20lbs. steel rails. This can be worked by men as well as by locomotives. Rails of this type can be had without sleepers for Rs. 3,500 per mile in Bombay, and cost delivered at Ajmere (about 700 miles up-country) Rs. 5,000 per mile. Complete with steel sleepers the cost would be about £450 per mile in England. The market varies. Steel rails' f. o. b., cost £6-10-0 per ton in January 1882 and only £4 per ton in July 1886. It would be advisable to have a good stock of curved pieces, points, crossings, turntables, &c., so as to make the line thoroughly efficient.

Rolling-Stock.—There are many types of wagon suitable for different purposes, which can be seen in any illustrated catalogue. The type of wagon I would recommend as the best for all ordinary purposes is known as the platform wagon,—See Diagram *A*. The frame consists of channel iron beams with iron corner uprights and hand bars drilled with holes for fitting iron or wooden sides and ends. The length is 4ft. 6in. It will carry ordinary merchandise not weighing more than 15 cwt. and cost in England £518-0 only. The dead weight is reduced to a minimum which is a consideration in haulage by coolies, and these wagons can be adapted for nearly every purpose. Two coupled together, as shewn in the sketch,—See Diagram *B*—can be adapted for carrying heavy logs up to 30 cwt. in weight. If fitted with stanchions, at each end to carry a broad wooden seat and provided with overhanging foot-boards, each wagon could carry six men sitting back-to-back, facing outwards as in an Irish car. More elaborate cars for 1st and 2nd class passengers are used, but I am merely suggesting the type most suitable for general use and how it can be adapted for other purposes.

The estimated cost of transporting 50 miles of 2-feet gauge portable railway and 400 wagons per 100 miles would be I believe about Rs. 8,000, but as Government have an interest in most other Railways this would not be all loss, and in making concessions to other Railways in future some condition might be made to meet a contingency of this sort.

Sir Edward Buck proposes that the Inspector-General of Forests should be asked whether any of his Forests are in a position to admit of the utilization of portable tramways, and that if the circumstances are favourable a practical experiment should be tried. It is possible the Inspector-General of Forests may not be able to advise the introduction of portable tramways, or, if introduced, circumstances may not be as favourable as desired, and in either case this would be fatal to the proposal.

So convinced am I of the advantages that must follow the use of portable railways when used under ordinarily favourable conditions, and (putting aside the immense advantages that would accrue to Government in time of war or famine from their use) the certainty that they can be made to earn a fair return on their original cost that I trust I may be permitted to offer a few suggestions.

I would suggest Government getting about 200 miles of 2-feet railway 20 or 22lbs. to the yard, complete with rolling-stock of the platform wagon type described above. It is no use attempting experiments with half measures; 50 miles might be sufficient for an experiment, but on an emergency might fail just because more was required.

These 200 miles might be laid down in different parts of India, in various lengths from those points where the exports or imports or passenger traffic shewed the best prospect of a good return, as feeders to existing lines, one end always being in contact with a railway so that they could be easily taken up and transported.

No permanent station buildings or platforms should be made. Everything should be carried out with rigid economy and only what was absolutely necessary be permitted. Goods and passengers could be taken in at every village along the route, and the speed be, say, 8 or 10 miles an hour or more if required.

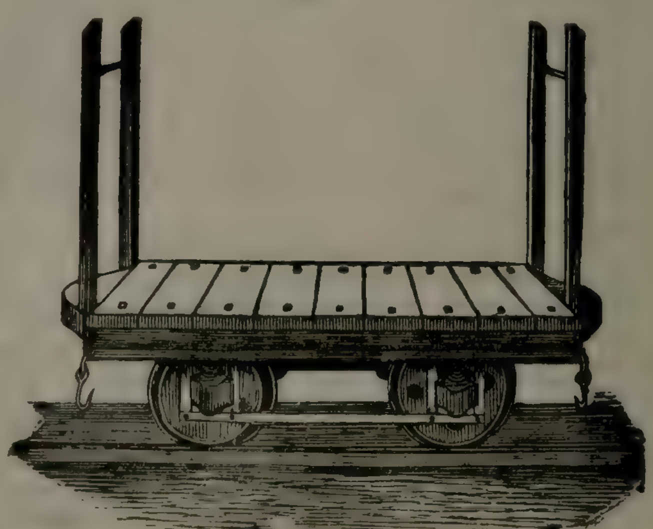
In this way the largest return would be secured with the smallest outlay, and the line would be certain (judging from other lines which have not had such favourable conditions) to pay a good return.

For the working staff I would propose to enlist a special body of men, liable to serve anywhere; then when a war or famine occurred the whole line might be taken up *in a few hours* telescopically from the furthest ends, conveyed wherever required, laid down in a few days at the outside, and be worked by the same staff complete; men who were accustomed to the work.

This would perhaps cost an outlay of between 20 and 30 lakhs, but I doubt if the Government could invest this sum in any more remunerative way, and I would strongly urge no half measures if complete success is desired.

Supposing, however, that the Government are not prepared to spend this money, I think it might be possible to induce private companies to do so, if liberal terms were

A



B

offered. The Government, say, to guarantee interest on the capital, as allowed to other Railways, with the special condition that in war or famine the Government should have the use of the railway, paying all costs of removal, relaying, compensation for loss and a *liberal additional rate* of interest during the time the line was taken up by Government. On some such conditions I believe the capital would be subscribed at once. In some way of this short the interests of the shareholders might be guarded and at the same time, without going to any expense, the Government would have a large supply of portable railway and plant *in the country ready for immediate use*; and until it was required for war or famine it would be opening out parts of the country which are only waiting for means of transport, and so even now would be a direct advantage to the Empire. A good investment I believe in a financial point of view and certainly I think one of the best preparatory measures against famine or war.

THE GOVERNMENT HARNESS AND SADDLE FACTORY AT CAWNPORE.

ANY traveller passing through or being on a short visit to Cawnpore should not miss the opportunity of visiting these works, which are conducted under the able management of Colonel Stewart, to whom is due the honor of being the originator and organiser. In ordinary times most, if not all, requirements of the Army Department are met from these Establishments, and the history of the initiation and development of the latter, which has rendered the former independent of the English market in this particular branch of its requirements, though short, is not devoid of interest and instruction. In 1859, when the city of Cawnpore was once more restored to peace and quietness from the horrors of the Mutiny, which had disorganised society and ruined trade, Colonel (then Captain) Stewart received peremptory orders to enter upon the work of reviving the staple industry of the country—that of manufacturing leather—which had declined during the troubles that had preceded the year just named. Thereupon Colonel Stewart lost no time in deciding upon the spot—at the site of the old Fort—organising labour, collecting materials, and putting the work in motion. Despite all discouraging circumstances and trade competition, which was dictated from mere feeling of jealousy, he tided over all his difficulties, and the present works bear testimony to the skill, judgment, and energy of a man, who deserves the gratitude of the interested Cawnporites, and a better recognition at the hands of Government than that recently received.

The tannery and curriery department is conducted on the English principle. The raw material, consisting of hides of horned cattle, sheep and goats, are brought in by contractors from whom they are purchased at the market rate. Cow hides of good quality are sold for from four to five annas per lb, and those of buffaloes at three annas per lb. As soon as the hides are taken delivery of, they are subjected to the process of *liming*, which consists of steeping them in a solution of caustic lime, for a definite period, generally one month, in order to deprive the hides of their hairy coating and any fleshy remnants.

While yet undergoing this process, they are subjected to the operation of *stocking* or *beating*, which is done by means of steam machinery. The caustic bath, which acts destructively on the leather, cannot be avoided, as no other method is known to work equally well. The hides when drawn from the tanks present a greyish appearance and are of gelatinous consistency. They are now *bated*, that is, thrown into a bath of bran and water in an advanced state of fermentation. Here a chemico-mechanical change takes place; the pores of the skin or hide, which had been filled with lime when in course of liming are now acted upon by the acid and the lime removed, thereby rendering the leather spongy or permeable to the action of tannin. The hides are then weighed and all traces of roughness on the flesh side of the skin removed with a blunt knife. This done they are removed to the tannin bath composed of the following ingredients.

Babul bark	80%
Myrabolum or burr	16%
Divi Divi	4%
	100

The hides are allowed to remain in this solution for 30 days, and at intervals they are *handled*—that is, drawn from the tank and exposed to the sun to deprive them of gallic acid and oxygen. *Dusting* or immersing them in a stronger liquor is the next operation. This is done by spreading pulverised babul bark between the hides to maintain the strength of the solution. The period necessary for this operation varies from 120 to 130 days, during which the hides are less *handled* than before.

For the last time, and that for a period of 150 days or thereabouts, they are put in vats of new liquor. Thus, it will be seen, that before the hides are ready for the curriery, they have to undergo manifold operations extending over 11 months. The hides ready by the completion of the last process are now removed into the *curriery*, where they are thrown into the *scouring* tanks, located in large covered-in buildings, and thence to the *stone beds*, where they are partially dried, pressed out by machinery, and then stretched on the *currier's beam*. Here the skins are further cleansed of all remaining adherent flesh under the skilful application of the *shaving knife*.

After a variety of other processes mostly performed by machinery, the leather is now ready for storage or manufacture of leather goods.

The contract system pervades every department and its advantages are equally shared by the employer and the employed. There are more or less 1,500 hands employed daily at these works supervised by 13 Europeans.

The aggregate annual outturn of prepared goods amounts to 350,000lbs and nearly half a million lbs of leather are annually *curried* here. Some idea may be formed of the magnitude of the operations when we state that the value of the work done amounts to no less then fifteen lacs of Rupees per annum.

We cannot take leave of our subject without expressing our inability to solve the ever present enigma, *viz.*, that this country possessing, as it does, so many natural advantages and replete with products, vegetable, animal, and mineral, should be still dependent on the English market for a variety of manufactured goods, which could be easily supplied locally, if the same fostering care and encouragement, whose influence has brought the Cawnpore Army Harness and Saddlery Factory to its present efficiency, were extended to various other industries, which are on the decline or struggling for existence in India.

We think there is ample room for more such factories, and the enterprising public should come to the fore to supply the want.

It is indeed an anomaly, if not a standing reproach to the intelligent trades-people of the country, to allow cotton, wool, hides, horns, and a hundred other kinds of raw materials, to be sent out of the country to return to it as manufactured goods burdened with transit and other charges, which preclude many from enjoying the blessings of civilization. No country in the whole world (except, perhaps, parts of Africa) enjoys the advantages of such abundant and cheap labour as India, and yet she is not in a position to compete with other countries or to supply her own wants.

In the cotton industry, Bombay, of all other parts of India, stands foremost, but when considered relatively to the wants of the 250 millions, it is but a drop in the ocean.

For this retrograde state of things the people of the country are not so much to blame as the Government whose precepts are not practices, and whose policy does not possess that *true* ring of honesty, which we had deluded ourselves it had.

CRISPIN.

THE CONSTRUCTION OF THE HONEY-CELL;

OR,

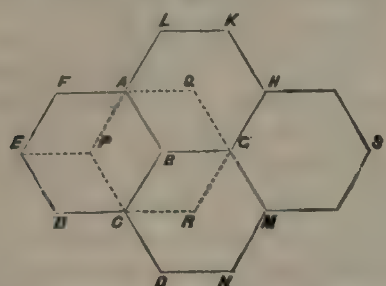
THE BEE AND HIS D. P. W.

BY A. EWBANK.

IV.

IF the progressive bee-party had conservative arguments and conservative sentiment to overcome before they could launch out from the time-honoured circle and land themselves on to a hexagon they must have found it at least equally difficult to "change their base" in the manner we proceed to describe. Every schoolboy—among tailless bipeds—knows that plane geometry is easier to understand than geometry of three dimensions. The change from *fig.* 2 to *fig.* 5 was a plane change. The change of base now to be hazarded is a change in three dimensions.

Fig 5.



Let A B C D E F in *fig.* 5 be considered for the present the plane base of an upper cell. Let P, its centre, be lowered down the axis of the cell for a certain distance x. Let B move vertically up through an equal distance. Let A and C be unmoved. We may thus imagine that the rhombus P A B C has rotated about its one diagonal A C and that the other diagonal has stretched so as to allow P and B to have strictly vertical movements. Thus the figure remains a rhombus. Let the rhombus P A F E be similarly treated, P sinking through the same distance x. Let P C D E have corresponding movements. Then the plane base has been changed into a three-face pyramidal base These faces jut up and intersect the vertical walls of the cel in a zig-zag manner. This is indicated in *fig.* 7 by the zigzag line—or broken line as we say in solid geometry—AB′CD′ EF′A. The new shape—if we start from a cell of given height and given cross-section—is known if we know x or if we know the angle between two edges of the new pyramid or if we know the angle between two of its faces. The inside angle between two of the faces that meet at P we shall call 2ϕ. The inside angle between two of the edges at P we shall call 2θ. In *fig.* 7 the angle 2θ is A P′ E. This angle equals A F′ E or C D′ E. The angle 2ϕ is not shown in this figure. We shall see that the bee has chosen such a shape for the base that $2\phi = 120°$, and that θ is defined by the equation $\text{Cos } \theta = \frac{1}{\sqrt{3}}$. This makes $2\theta = 109° \, 30'$ roughly. To show that either of these angles implies the other is a problem in ordinary geometry. Ordinary geometry is entitled to use Algebra and Trigonometry as allies. To show that either of these angles gives a cell which has the curious property of being most economical of surface (*i.e.*, building material) we might by ordinary geometry calculate the surface for these angles and the surfaces for other values of 2θ or 2ϕ. We should thus experimentally prove our theorem. Or we might by the aid of the Differential Calculus inquire what value of 2θ gives a minimum surface. This we do later.

Fig 2.

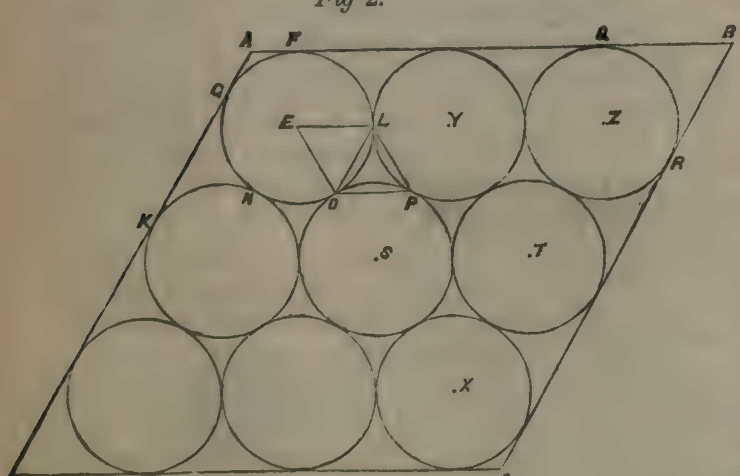
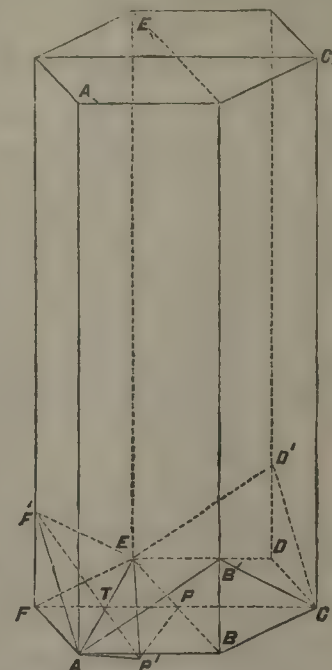


Fig. 7.



If we imagine an insect to examine the new base boundary he will have an uphill and downhill journey along the lines AB′, B′C, CD′, D′E, EF′ and finally downhill from F′ to A. This zig-zag boundary looks puzzling to us and it would have been more puzzling to a generation of bees that found themselves transported in a moment from the old plane base to the new perfected—the reformed—or as the conservative bee-minds would say—the new *de*formed base. And if the progressive or the radical party had proposed to change the old plane (and plain) base at once into this convoluted shape their proposals would have been scouted by nearly all the bees who were bees of judgment and experience. In that cell *fig.* 5, whose centre is Q, let the rhombus A Q G B be tilted about the line A G. If we treat the rhombus Q G H K and the rhombus QKLA in a similar manner we have the same three face pyramid for the base of the cell A B G H K L. Let the cell B G M N O C be also thus modified. If now we look at the face P A B C of one upper cell, Q A B G of a second upper cell, and R C B G of a third upper cell we see that these faces in their new sloping positions constitute another pyramid at whose raised vertex we are looking and which on the other side of the paper gives us a new base for a new under cell to be dovetailed between the three upper cells whose centres we may call P, Q, R. Thus any three upper cells which have three vertical walls (one from each pair of cells) meeting in one vertical line—as the line through B—have on the other side an inverted cell wedged in between them.

This dovetailing is geometrically more complicated than that of *fig.* 6. Had the bees commenced to modify the circles of *fig.* 7 before they shifted them *as* circles, they would, as we have seen, ultimately have obtained square-section cells and they could have dovetailed them back to back as is shown in *fig.* 6. But having committed themselves to the *fig.* 2 grouping, which afterwards brought them to hexagons, they were naturally led to the more complicated one—between—three dovetailing arrangements which we have now described. The arrangement of *fig.* 6 is a simpler one—between—two or alternate dovetails. Thus the accident of shifting their circles before

they changed their shape has affected their whole subsequent history just as the after history of one nation of tailless bipeds was built on the accident that a Norman biped called William overcame a Saxon called Harold some eight hundred years ago.

But we must not imagine that the D. P. W. among the bees saw its way clearly from the first to that pronounced pyramidal dovetail which the cells finally received. Perhaps P at first was only lowered slightly the bees working at the P cell having no thought of shifting *re* raising B. Similarly Q and R would be lowered slightly. But the bees in the opposite cell would push B (their centre) forwards, and the upper cell bees would accept this movement. Thus we should have the plane hexagonal boundary of one cell replaced by a very slightly zig-zagged line. This zig-zag line came on them as an unforeseen consequence of their engineering changes. Had it been clearly forecasted as an inevitable result in its final outrageous shape—of the proposed engineering changes—some conservative old gentlemen among the community would have been supplied with a great "unanswerable" argument against the folly of these unconstitutional innovations.

But though the object was engineering or dynamical yet after it was carried into practice the bees might perhaps discover that the change was economical of wax—that they were "saving on the estimates." This discovery would be a fine weapon to flourish in the faces of the opposition party. For, generally, changes, though they may be undeniably necessary, are confessedly and undeniably costly. It would also serve to neutralize the æsthetic objection that might be felt to the painfully irregular base outline. Thus the charges of "utterly unnecessary alterations" or of "tampering with old-established customs" would gradually be silenced. The Engineer in charge if he found that wax was being saved might be encouraged to proceed further. For the dynamical aspects would be improved by a further development of promontories and so long as these were accompanied with a continued diminution of material and no other disadvantage he would be willing to push the process beyond the point where mere motives of stability would drive him. But when he reached the point beyond which the surface would begin to demand again that material which it had previously given back as savings the Engineer might stay the ever-elongating promontory and might keep it at that figure for the future. Architectural necessities had already been fully satisfied and mere financial conditions were now most favourable. Therefore the honey cell might become stereotyped and subsequent generations might so maintain it.

We have thus endeavoured to show that the bee in altering the shape of his cell was at no time especially bent on saving building material. He thought of using up waste spaces or he thought of getting increased stability. Economy in wax whether obtained by making one wall serve for two cells or by giving his base a slope was simply an incidental advantage which possibly he learned to appreciate. Nor does the bee seem to have occupied itself with the question how far the volume of the cell would be changed for the better or the worse. No doubt in utilising waste spaces he is directly thinking of volume. But when in *fig.* 5 the centres P, Q, R are lowered and the opposite centre B is raised the volume added to one cell is subtracted from some others. We shall see that the lowering of P and the raising of B, F, and D left the volume of the P cell unchanged. Thus we have the refined purely geometrical question—how shall we modify the hexagonal prism to give the surface a minimum while the capacity remains constant. This is that geometrical problem which probably many mathematicians have applied the Calculus to solve. But it does not appear that such a problem ever presented itself to the mind of the bee.

For suppose that a tailless biped was designing a house or a bridge. Is not the amount of material the very *last* thing he would study? If he builds a house he thinks first how many men it should hold. If he builds a bridge he thinks first how much traffic it should take. Secondly, he thinks what form he should give the house that it may not fall by its own weight—or what form he should give the bridge that it may bear its own weight *plus* the weight of expected traffic. *Lastly*, he proceeds to calculate the amount of material he will require. To suppose that the bee inverted this reasonable order is to violate the golden rule that every man or bee shall be assumed to be innocent (of professional folly) until he is proved to be guilty.

A man in designing a structure thinks what he will put inside it. If it is a dwelling chamber it is spacious to move about in and lofty for appearance as for ventilation. If it is a larder it is made smaller and not lofty. For a central space without shelves is here a space wasted. The honey cell is a larder. The bee makes it long enough and wide enough to suit the dimensions of his own body just as a man does in his larder—or a banker in the drawers in which he keeps documents or a housewife in the pudding dish in which she prepares a meal. The man at his larder, the banker at his drawer of papers, or the housewife at her pudding dish, would be very much surprised to be told that the first and most important question was the amount of material used up in making these three articles. The bee as I think began his existence as an ordinary sensible Engineer. He ended, as a reward of his professional virtues, by becoming a wise Geometer.

Again, we know that of all bodies having a given volume the sphere is most economical of surface. Therefore it seems that a hemisphere is an excellent shape for an *open* vessel if economy of material is the first consideration. If therefore the bees were first of all bent on saving their wax they would have made bowl-shaped cells and then dovetailed them into stout hexagonal prisms to make one wall serve twice. And the purely geometrical problem which we should have to solve would be as follows: Find that shape of cell which is absolutely most economical when cells are grouped both in layers and back to back and the dovetailing is strictly subordinated to economy of material. But this is not the geometrical problem which the Calculus has been used to solve for the bee cells.

In the bee cell problem we have the original height (or length) of the cell given. We have also its cross-section known to be hexagon and the side of this hexagon also given. We have then while keeping the upper part of the cell unchanged so to modify the lower part as to have a three-faced symmetrical pyramid for base whose faces are to reach as deep below the original base as they reach above it. All these conditions being observed—please find x the depth of lowering or find some other element such as 2θ or 2ϕ which will equally well define the particular pyramid to be selected.

As to the original dimensions of the cell they had as we think some *personal* relations to the bee. A cell must not be inconveniently long for the bee to reach into to store or remove honey. It must also not be too narrow. A number of small cells are more convenient than one large cell because then each bee can have his honey collecting work fairly allotted to him. When the honey is being used up in the winter the rate of consumption—or the stock remaining can be more readily gauged or controlled. If, as is thought, the bee possesses its formic acid not primarily to be injected through its sting into obtrusive humans as other unscrupulous robbers, but to pickle its own honey and thus to help it to keep good, then it will be convenient to have the volume of the cell in some relation to the amount of formic acid easily at one time secreted. In a very large cell it would be difficult to estimate how much formic acid should be injected, and, if the right quantity were injected, it would perhaps be over strong at one place and insufficient at another because honey, being a viscous fluid, would not let the acid readily and uniformly be diffused. These considerations, as it seems to me, were what chiefly determined the size and shape of the original cell. Subsequent modifications either on engineering or on wax-economy or on other grounds were so carried out as never to lose sight of the original *personal* conditions.

(To be continued.)

VITAL STATISTICS.

When an individual of the *genus homo* has passed three score and ten he shortly after succumbs to some accidental complaint in spite of Parr's life pills and all other potent—or at least patent—prolongators. Here there seems little cause for wonder; a machine has simply worn out. But a similar stage of decline and disappearance would appear to attend communities. Nor does it ever happen that when a people is nigh unto death, there will come to it what doctors call a turn for the better and it takes a fresh lease of the centuries. Yet if we look into the cases where nations are broken up, we do not find that the great proportion of individual men and women are in physical or mental decrepitude. We have, as it were, a watch, which after keeping due time for many years loses the power to go. We open out the works and take them entirely to pieces. We have thus so many wheels and an assortment of other items. These we use together with fresh apparatus in constructing other watches and they readily perform their parts.

What is the cause which kills the national life, while the lives of individuals are left so largely unimpaired? The Assyrian Empire came and went. The Egyptian power rose and fell. Other dynasties had their day and then their strength decayed. The Romans easily overcame the world, but they themselves were easily overcome. What is that poison which has power to diffuse through the veins of a people—to bring feebleness, paralysis, death? That poison is luxury.

When the rulers of a people or a tribe live as simply and as raggedly as the tribe—when its aristocracy is an aristocracy of physical excellence—of capacity and willingness for hardship—of delight in a strenuous life—that people or tribe is enjoying its youth; its old age is yet in the future. When in consequence of the accumulation of wealth a people breeds a class of men whose only function is to consume the large inheritance of the past; the seeds of corruption are in that people—a finger is writing on the wall.

In a primitive stage of civilisation no member of a tribe is likely to starve, unless the whole tribe starves with him. Nor is it easy for any member to accumulate enormous wealth. Wealth in such a community is embodied in bulky and perishable articles—as, for instance, in cattle of kinds. The owner of such property cannot readily consume most of it on himself. A small army is necessary to protect it and they live in the goods they preserve. In a stage of civilisation highly developed a man may walk down a crowded street and his name may be unknown to numerous passers-by. His property may consist of the clothes he wears and a small piece of paper in his hand. That small piece of paper may make him the possessor of untold millions. Over these possessions his power may be uncontrolled. Ninety-nine per cent. of it he has power to dissipate in utterly selfish and utterly irrational enjoyments.

Civilisation is mainly an intensification of the difference between one man and another. Its happiest children are made more happy; its unfortunate children have their misery deepened. The Australian savage or the South African bushman has occasionally to endure hunger. But wild men, like predatory wild animals, usually make captures sufficient to sustain their life and strength. For the rest the savage has freedom—he looks up at an open sky. The ordinary dangers of his daily life provide him with that healthy excitement for which under other conditions men are fain to have recourse to gambling or intoxication. He is not driven to camp in crowded alleys reeking with filth and pestilence.

On the other hand, in a modern city the selfish consumer of almost unlimited wealth might not appear an object of envy to a normal healthy savage. This latter whose bodily strength, activity and endurance are preserved in vigorous training would note with contempt the helpless physical condition to which luxury has reduced the other. In the victim of over-civilised civilisation the stomach may have grown the predominating member and all the other organs be but satellites ranged round in waiting to obey its summons. The old Greeks held, that if a man studied only his personal interests and had no thought for those of the community he should be called an idiot.

The utmost degradation which poverty shows us in some of our modern cities is an extreme in one direction of the tendencies of modern civilisation. The degradation of unlimited personal wealth consumed in irrational personal gratifications shows an extreme in another direction. Between these there must be a great preponderance of healthier average lives to preserve the life of the nation. Should these average lives cease greatly to preponderate the country possibly will be cured by civil war. But it is more likely that its growing rottenness will invite the attacks of healthier peoples, and that its national life will be destroyed. A wounded people or a wounded wolf has seldom the chance of recovery. It is set upon and devoured by its neighbours.

When a country has become sufficiently corrupted for a small minority to be competing with each other in luxury and foolish ostentation while a much greater number are dying around them of diseases engendered of privation, it is not merely useless to expect the corrupted wealthy minority to sacrifice their acquired tastes to promote the public good, but it is certain that no remedy which these few could apply, could forthwith cope with the evil. The mere distribution among the poorest classes of the wealth which belongs to the few would cause a week or two of riotous enjoyment, but afterwards the misery would be renewed.

For the evil is mainly an evil of degraded natures, of brutalised tastes, of densest ignorance that knows not itself to be ignorant and will not listen to knowledge. Among the wealthier classes there are men and women who would cheerfully sacrifice the bulk of their wealth and would give their time and energies could they only see some certain way to the improvement of their poorer brethren. The able statesman, the eloquent preacher, the thoughtful man of letters, have all these questions before them to study, they have all this great problem to solve.

BRITISH INDIA INVENTIONS AND DESIGNS BILL, 1887.

[*Specially Reported for* Indian Engineering.]

The Committee of the Institute of Patent Agents having, on the 4th March last, carefully considered the proposed Indian Act, were of opinion that the Bill does not vary considerably from the Act No. 15 of 1859 and it appears to be mainly designed for the purpose of avoiding certain difficulties which have heretofore prevailed. To meet these difficulties it is stated that it has been decided to incorporate in the Bill certain provisions suggested by the Patents, Designs and Trade Marks Act of 1883, 46 and 47 Vic., Cap. 57, as amended by 48 and 49 Vic., Cap. 63.

The main features of the suggested alterations are as follows:—

1st.—The Bill provides for concurrent applications in the United Kingdom and in India.

2nd.—It defines the time in which an application for the exclusive privilege in India must be applied for when there is an English application or grant. The limit is 12 months from the actual sealing of the English Patent.

3rd.—It provides for enlargement of time beyond the six months for filing the specification after the order authorizing the filing of the same.

4th.—It provides for the maintenance of the privilege by payment of renewal fees, and for the enlargement of time for payment of same.

5th.—Section 27 of the English Act has been adopted, which provides that the grant shall have the same effect against the Crown as against a subject.

6th.—Section 22 of the English Act, which relates to compulsory licenses, has also been adopted.

7th.—The Act incorporates the main principles of part 3 of the British Act of 1883 relating to the Registration of Designs.

While the Committee, on the whole, consider the Bill fairly satisfactory would suggest the following modifications or alterations :—

(1). Referring to section 1, sub-section 2, it would be desirable to define more distinctly the extent of the grant, by stating which provinces it covers.

(2). Section 4, sub-section 1. The definition here given of an invention should be amended so as to read as follows :—

"An invention includes any manufacture, or an improvement in any manufacture."

(3). Section 5, sub-section 1, should be altered by the substitution of the word "Invention" for the word "Manufacture" so as to accord with the alteration which the Committee propose in section 4, and these two amendments the Committee think will more clearly define for what an exclusive privilege may be obtained.

(4). Section 5, sub-section 3. The Committee consider that in no case should models be called for and would remark that drawings and descriptions are deemed sufficient in nearly every country where patents are granted, and if models are to be furnished the cost of obtaining an exclusive privilege will in many cases be largely increased.

(5). In regard to section 6, sub-sections 4, 5, 6, and 7, which provide for reference to experts and payment of their fees by the applicant, it is considered that this should be omitted, as it will bear unequally on applicants, will often invariably increase the expense of an application, and might in some cases be very prejudicial to the rights of the inventor.

(6). Under section 7, sub-section 2, the Committee find the same objectionable practice as that which arose under the British Act of 1852 and which was known as "racing for the seal" may obtain. The process of "racing for the seal" may be better explained by giving an example of what might occur under the Indian Act. *B* makes application for the grant of an exclusive privilege. Two or three weeks after *C*, another inventor, also makes application for a grant for identically the same invention. *B* has, under these circumstances, by virtue of section 7, sub-section 2 of the new Bill, a preferential claim and obtains the first order authorising the filing of his specification, but owing to his being resident in the United Kingdom or from other causes the filing thereof is delayed. In the meantime *C* obtains his order and at once files his specification before *B*. The consequence is that *C*, although the later applicant, obtains an exclusive privilege earlier in date than that of *B*, the first applicant.

This objectionable practice, which was considered a hardship on the first applicant, has been remedied in the United Kingdom by section 13 of the Act of 1883, and it is suggested that the following sentence should be added to sub-section 2 of the Indian Bill :—"Provided also that in case of more than one application for an exclusive privilege for the same invention the granting of such exclusive privilege to one of these aplications shall not prevent the granting of an exclusive privilege on an earlier application."

(7). Referring to section 8, sub-section 1, the Committee consider that the exclusive privilege should extend from the date of filing the application, and not from the date of filing the specification. This alteration will be necessary in consequence of the proposed alterations, to make this section accord with section 7, sub-section 2. If not so altered, priority might be acquired by the second applicant who first filed his complete specification under the order as previously explained.

(8). Section 8, sub-section 4 (A). The Committee think that the enlargement of time allowed for making payment of renewal fees should be extended from 3 to 6 months.

(9). Referring to section 12, the Committee are of opinion that the applications should be numbered consecutively and dated as of the day on which they are received.

(10). In section 15, the word "Manufacture" should be altered to "Invention" to accord with the proposed amendment of sections 4 and 5.

(11). Sections 29 and 30 deal with actions for infringement. According to these sections an infringer is debarred from pleading as a defence many of the objections ordinarily raised in a patent suit, such as want of novelty or utility, leaving in fact only the plea of no fraud and prior user by defendant.

In order to defend an infringement on any other ground, it would appear that the infringer must apply under section 30 for revocation of the exclusive privilege. The effect of this will be to entail on a defendant the necessity of himself instituting an action for revocation, thus entailing the additional expense and trouble of carrying on two separate actions. The Committee are of opinion that sub-sections 2, 3, and 4 of section 29 should be omitted, so that the usual pleas may be put in by a defendant in a patent suit.

(12). In section 27 the word "specification" will require to be altered to "application" if the recommendation made in reference to the date which the exclusive privilege should bear is adopted.

(13). In regard to the fees, it is proposed by the 4th schedule that taxes should be payable every two years after the date of the privilege, up to the 10th year, the fees commencing at £5-12-6 (75 rupees) and increasing to £11-5-0 (150 rupees). The Committee suggest that it is desirable that the fees should be payable annually and that the amount should be distributed over the entire term of the privilege in equal amounts. This will assimilate the practice to that of most other countries and render the taxes less liable to be overlooked.

(14). It is to be noticed in the Bill that it proposes to continue the practice of granting "exclusive privileges" in lieu of granting leases. Probably there is no serious objection to this, as they are tantamount to the same thing, but it is considered that inventors would be more satisfied with the issue of a document as reciting the privilege, than by the mere issue of a certificate, stating that a specification has been filed and which conveys no meaning to the inventor or others.

In conclusion, the Committee observe that the Bill does not provide for the Registration of Trade Marks. This, the Committee think, is a serious matter, as although there have been a considerable number of Trade Marks registered in India the registration is of very doubtful value and it is deemed desirable that this uncertainty should be cleared up and that the Bill should provide for the registration of Trade Marks.

MINING IN ENGLAND.

(From our own Correspondent.)

A NEW air-compressing plant has been erected at the Dolcoath mine, and it is intended that at least 12 boring machines will be kept at work by its means. Working at a slow speed it will maintain a pressure of 70 pounds per square inch at a depth of about 900 yards or ½ mile, and will be piped another 400 yards before reaching the working. We are far behind our continental neighbours in making use of electrical transmission of power, which must ultimately prove superior to all other systems.

Attention has been largely directed in Germany to the use of basic slag as a manure, as a result of trials at a farm near Ferryhill. It was found that the phosphoric acid in basic slag is more easily assimilated by plants than the phosphoric acid in mineral phosphates, and that it is nearly as efficient as precipitated phosphoric acid. The basic slag is prepared for use by grinding to a very fine powder; attempts have been made to render it soluble with sulphuric, but its use does not appear to be as profitable as the simple ground slag.

Trials have been made of molasses and other residues from the manufacture of sugar in place of pitch in the manufacture of briquettes from small and duff coal. The proportion used is from ¾ to 1 per cent., diluted with water to the required consistency. The trials have proved very successful, as the brick bears rougher usage and is produced at a lower cost.

A new mining cartridge for blasting in coal mines has been invented by Dr. Kosman of Breslau. This cartridge depends for its action upon the rapid evolution in the bore hole of a large volume of hydrogen gas, the resultant pressure of which is to detach the coal.

The deepest bore hole in the world has been abandoned by the Prussian Government in Saxony. It was being put down in search of coal, and was abandoned at a depth of 57,000 feet, on passing into porphyry.

The recently published experiments of the Prussian Fire-damp Commission upon Coal Dust have been ably reviewed by Messrs. Mallard and LeChatelier who have published their conclusions, *viz.*:—

Combustions of coal dust are not, to speak exactly, explosions; indeed, they only produce insignificant mechanical

effects for most dusts, and always much more than those of fire-damp explosions, even for the most exceptional dusts.

The combustion produced at any point does not extend indefinitely over the whole area covered with dust. The length of this ignited portion is proportional to the intensity of the mechanical action which raised the dusts and ignited them. This length is always limited and is (under the effects of blown out shots of about ½ pound of powder) about 65 feet for most dusts, and only extends to 200 feet in the case of very exceptional dusts. Consequently an explosion which extends for a considerable distance is not an explosion of dust.

It may therefore be concluded that dust, in the absence of gas, does not constitute a very serious form of danger, and that it can only exert an important influence by aggravating the consequences of an explosion of gas.

The influence of gas upon the combustibilities of dusts, if it is not altogether *nil*, is at least much less important than was assumed at first. It appears that as long as the proportion of gas contained in the air is not dangerous of itself, dusts have little, if any, influence; they only have the effect of augmenting the length of the flame of a shot, and consequently the quantity of gas which may be burnt in the vicinity of its flame.

Lastly, the co-existence of coal dust and gas does not appear to create any special danger, so long as each of these bodies singly is not of itself dangerous.

NOTES FROM HOME.

(From our own Correspondent.)

In the House of Commons Sir John Gorst said the estimated capital to be expended on Indian Railways in 1887 was 974 lakhs of rupees. By the end of this year it was estimated that 167 additional miles of Railways in India would be opened. The construction of a line in Bengal 784 miles long had been entrusted to a guaranteed company. The line to Quetta would be opened at the end of March. 90 miles of the Beloochistan Railway would be opened immediately. About 100 miles of the Indian Midland Railway which was being constructed in several sections simultaneously would be opened in the course of the year. Sir John also stated that the Government of India has no idea of departing from the policy of constructing Railways in India by the Government itself or by companies under a guarantee. That any proposal to dispense with a guarantee would no doubt be received favourably. And that it is not intended at present to call for offers to construct additional Railways under a Government guarantee.

There has recently been given a private exhibition at Lambeth of a new departure in Railway locomotives. The peculiarity in this invention is the absence of all that cumbersome machinery seen in the locomotive in use on every Railway. At first glance one sees simply an iron platform alike at both ends resting on four wheels. On this platform is seen a boiler at one end of which stands the driver. With one hand resting on an erect steel rod to his left he commands the locomotive at will. With this same appliance he controls steam and steam breaks with perfect ease. Though turned full on in an instant, thus sending the locomotive away at its topmost speed, there is no apparent jumping, tremulous motion, or tendency to jar. What strikes one as extraordinary about this new locomotive is the absence of link motions, eccentrics and rods, and yet the very largest effective power is claimed for it. By means of a most perfect arrangement of valve motion the power is distributed to two cylinders contained in boxes fixed at each corner under one end of the platform. Mr. Parnell, the inventor of this locomotive, has however to see his new invention practically tested on the hard facts of Railroad wear and tear.

The recent accident at Sedgley Junction on the London and North-Western Railway adds another to the long list of similar cases which have occurred through mistakes in signal lights, both fixed and hand, and confirms the opinion that a white light should not be an all right signal. No such mistakes could occur if the green light were on all lines made the only all right signal lamp.

An incandescent gas lamp has at length been patented in which a solid material to be heated to incandescence has been brought to perfection by an Austrian. There are a great many advantages claimed for the "Welsbach" light over the old system, amongst which is that twice as much light is obtained as when the gas is burned in the old manner and that it can easily replace the old burners. This lamp has recently been tried at the Marlborough Picture Gallery when 56 lamps gave the most satisfactory results, and with regard to economy it is said to compare very favourably with any now in use.

Messrs. Wild & Co., of Oldham, have recently brought out a Power Hammer possessing the special feature of effecting a considerable saving owing to the arrangements by which the power consumed is proportional to the work done. This hammer is driven by a belt and a simple mechanism allows the intensity of the blow to be easily regulated at the will of the workman. The drawbacks existing in steam and power hammers are said to be obviated in this instance, and where light and moderate work is required it seems to be a most ingenious and practical appliance.

The official trials of some torpedo boats built for the Turkish Government by Messrs. Maudsley were made recently when mean speeds of 21·7 knots were obtained, the highest speed being 23·4 knots or nearly 27 miles an hour. The vessels are 126ft. long with 15ft. beam and have 3 cylinder compound engines.

Dredging operations and appliances was the subject of the Paper read at the last meeting of the Institution of Civil Engineers, the discussion included some description of Messrs. Priestman's appliances and was adjourned to the next meeting.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, April 2, 1887.

Baluchistan.

Mr. H. O. Walling, Assistant Engineer, is granted privilege leave for three months.

Mr. H. O. Walling, Assistant Engineer, is transferred temporarily from the 4th Division, Frontier Road, to the Office of the Superintending Engineer, Frontier Road Circle.

The services of Captain R. O. Lloyd, R.E., Executive Engineer, 2nd grade, Assam, on his return from furlough, are placed temporarily at the disposal of the Military Department.

Director-General of Railways.

Mr. H. L. Butcher, Assistant Engineer, 1st grade, is granted special leave for six months.

N.-W. P. and Oudh, April 2, 1887.

Buildings and Roads Branch.

Mr. J. Heining, Executive Engineer, 1st grade, is, on return from furlough, appointed to officiate as Executive Engineer, Meerut Division, Provincial Works.

Burma, March 26, 1887.

With reference to *Burma Gazette* Notification, dated the 24th January 1887, Mr. J. Wallace, Executive Engineer, 4th grade, temporary rank, received charge of the Bhamo Division, Upper Burma, on the forenoon of the 5th March 1887.

Burma State Railway.

With reference to Burma Public Works Department Notification, dated the 3rd instant, Mr. R. L. Campbell, Executive Engineer, 4th grade, made over, and Mr. W. Wiseman, Executive Engineer, 2nd grade, received, charge of the 4th Division, Toungoo-Mandalay Extension, on the forenoon of the 4th idem.

Mr. A. J. Oldham, Executive Engineer, 2nd grade, is granted one month's privilege leave, with effect from the morning of the 22nd instant.

Mr. G. Denchars, Assistant Engineer, 1st grade, is appointed to the charge of the Third Division, Toungoo-Mandalay Extension, during the absence on privilege leave of Mr. A. J. Oldham, Executive Engineer.

Bombay, March 31, 1887.

Mr. T. W. deWinton, Assistant Engineer, 1st grade, is allowed furlough for eighteen months with the usual subsidiary leave from the 1st May 1887, or any subsequent date from which he may avail himself of it.

Madras, March 29, 1887.

The following postings are ordered :—

Lieutenant-Colonel J. Pennycuick, R.E., Superintending Engineer, 2nd class, to the charge of the VI. Circle, to join at the public expense.

Mr. C. A. B. Target, Executive Engineer, 1st grade, to the charge of the Nilgiri Division, during the absence of Mr. W. B. de Winton on privilege leave. To join at the public expense when relieved from special duty.

The following transfer is ordered :—

Mr. J. W. Martin, Executive Engineer, 1st grade, sub *pro tem*, from charge of the VI. Circle to the South Arcot Division, to join at the public expense on relief by Lieutenant-Colonel J. Pennycuick, R. E.

Mr. J. Hannan, Executive Engineer, 1st grade, is granted furlough for six months from 1st May 1887.

Bengal, April 6, 1887.

Establishment—General.

The following promotions and reversions are made in the Engineer Establishment with effect from the dates specified :—

Mr. W. B. Gwyther, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, with effect from 16th July 1886, temporary.

Baboo Haran Chunder Banerjee, from Assistant Engineer, 1st grade, to Executive Engineer, fourth grade, with effect from 3rd August 1886, temporary.

Mr. R. E. Carter, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, with effect from 26th September 1886, temporary.

Mr. R. E. Carter, from Executive Engineer, 4th grade (temt porary rank), to Assistant Engineer, 1st grade, with effect from 1s- October 1886, reversion.

Baboo Haran Chunder Banerjee, from Executive Engineer, 4th grade (temporary rank), to Assistant Engineer, 1st grade, with effect from 19th October 1886, reversion.

Mr. W. B. Gwyther, from Executive Engineer, 4th grade (temporary rank), to Assistant Engineer, 1st grade, with effect from 24th October 1886, reversion.

Mr. T. Butler, from Executive Engineer, 4th grade (temporary rank), to Assistant Engineer, 1st grade, with effect from 16th December 1886, reversion.

Establishment.—Irrigation.

Baboo Raj Kissen Banerjee, Executive Engineer, 4th grade, sub. *pro tem.*, attached to the Mohanuddy Division, was on privilege leave from the 11th February to the 13th March 1887, both days inclusive.

Punjab, March 31, 1887.

Mr. B. G. Wallis, Executive Engineer, 2nd grade, from the Peshawur Provincial Division, which he left on the afternoon of the 28th February 1887, to the Umballa Provincial Division, which he joined on the forenoon of 4th March 1887, and of which he took over charge on the afternoon of the 8th idem.

Mr. F. E. Rose, Executive Engineer, 1st grade, from the Umballa Provincial Division, which he left on the afternoon of 10th March 1887, to the Dera Ismail Khan Division, which he joined on the forenoon of 13th, and of which he took over charge on the forenoon of the 16th idem.

With reference to Punjab Government P. W. D. Notification, dated 14th instant, Mr. E. E. Oliver made over, and Colonel J. P. Steel, R.E., received, charge of the Office of Chief Engineer and Secretary to Government, Punjab, P. W. D., on the forenoon of the 29th March 1887.

Notices.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Obituary.

WILLIAMSON.—April 10th, at Asansol, caused by a fall from a Dog-cart, Charles Williamson, M. E., of Seetarampore, aged 42 years.

INDIAN ENGINEERING.

SATURDAY, APRIL 16, 1887.

GOVERNMENT LOANS TO MUNICIPALITIES.

THERE is a *consensus* of opinion among the more intelligent portion of the community throughout India, that if local self-government is to be an established institution among us, it would be well for our rulers to reverse their latter-day policy of withholding pecuniary help in the construction of works of public utility by municipal boards. Considering that the country is on the event of an important change, although at present in its trial, there must be innumerable impediments in the way of effective management, and no opportunity should be missed of strengthening it by all legitimate means. The authorities confer a boon with the right hand only to take it away with the left, for it practically amounts to that, when local bodies are encouraged to undertake sanitary and other reforms, but are left to shift for themselves in providing the necessary funds for the purpose. This, to say the least, is a doubtful favour. Formerly they had to contend against one difficulty in the matter of obtaining the approval of Government and of the rate-payers to a proposed scheme; but now the difficulty has been enhanced by the imposition of a new obligation of resorting to an open market for loan.

Our rulers might, in this connexion, very properly take a leaf out of the book of the Home Government, which advances money to Corporations out of the public Treasury, at rates of interest varying from $3\frac{1}{2}$ to $4\frac{1}{4}$ per cent., dependent on the nature of the undertaking and the period covered by the contract, the higher rates affecting loans which, from the nature of the purposes, cannot be made repayable under 40 or 45 years. It is an understood fact, testified by every day experience that in India there is very little money available for public works, especially as regards municipal bodies. The ease with which Government can float a loan by giving a guarantee in terms of a written agreement, soon disappears in the case of an Indian corporation, inasmuch as the latter does not command that confidence which the ruling power enjoys; besides, the tax-payers would object to advance money to meet a contingent liability in the absence of an inducement of direct profit—hence the guarantee is neither sufficiently absolute nor indisputable.

To add to the embarassments of the Local Boards a Select Committee of the House of Commons, recommended a few years ago, a return to the system of guaranteeing interest on capital required for Indian railways. The direct tendency of this decision has been a growing reluctance on the part of capitalists to subscribe to an unguaranteed Indian project. And when the Government completely washes its hands of the responsibility of rendering pecuniary assistance it would be idle to expect the public to come forward with help. We see no reason why it should not lend money to the municipalities even at a slightly higher rate than that at which it itself borrows and thus remove all obstacles in the way of the progress of the people. It is true there is a provision in the Act to

amend the Local Authorities' Loan Act, 1879, which says that nothing in the Act shall be deemed "to affect the power conferred on any local authority by any special enactment now or hereafter in force, to charge its funds by guaranteeing the payment of interest on money to be raised for any purpose to which the funds of the local authority may be applied," but the clause is of no effect so long as the capital, the interest on which is to be paid out of local funds, is not forthcoming.

What material benefit does the above-mentioned clause confer when the requirements are not satisfied. The local bodies are told in the plainest of terms that they might employ the funds at their disposal towards paying the interest on a loan, but as the Government will not come to their rescue, and they are precluded from going into open market, owing to impaired credit, their position is in no way improved by the permission granted. It is not therefore to be wondered at that the refusal of the Government to assist municipalities to borrow money for works of local improvement, should seriously interfere with the advance of the country. If this were all there would not be much room for grumbling; but the authorities discourage by every means in their power, other resources for raising a revenue, without causing discontent among those who will be affected by it, *viz.*, indirect taxation, which every one knows is specially suited to the condition of the people of India. But our rulers have such a horror of this mode of reaching the rate-payers' pockets, and are so wedded to the *laseez faire* policy, that rather than make a departure from time-honored conservatism, they would sit with folded hands and see their efforts for the amelioration of the people converted into a Dead Sea fruit.

THE BRITISH NAVY AND ITS FOREIGN RIVALS.

Sir Edward Reed, formerly Chief Constructor of the British Navy, has been giving expression to his views upon the navies of continental countries, in an article he has contributed to *Harper's Monthly Magazine* for January. This is not the first time he has favoured the same Journal with his contributions; for in February and June of last year he discoursed therein of the British and American navies. Sir Edward, as a matter of course, shows a complete mastery of his subject both generally and in detail, and there can be no doubt but that all he says will be read with interest and respect. One point he dwells upon as of the most vital importance, and that is, that the part of the hull of every war vessel which may be said to lie "between wind and water" should be efficiently protected by armour. By this he means that portion which is included within a belt extending a few feet above and a few feet below water line. Shots from an enemy's guns cannot reach the hull much below the water line, because they would first have to strike the surface of the water, and that would cause them immediately to rebound upwards. And if they were to reach it well above the water line they could not sink the ship. It is, therefore, only at or about the water line that they are really dangerous. All continental Governments, which possess navies, appear to have recognised to the full the importance of armour belts. But in one respect their practice appears to differ from that of the British Admiralty, as recently exemplified in the *Inflexible* and *Admiral* and others of the same class. In these vessels armour is omitted altogether for about a hundred feet at either end. In France two such partly belted ships were commenced some time since, *viz.*, the *Brennus* and the *Charles Martel*. But Sir Edward says these vessels appear to have soon fallen under suspicion, and that there has been a conspicuous absence latterly of any desire to complete them for service.

He goes on to say that if a ship is not intended to close with an enemy, or to fight her anyhow and anywhere on the open sea—which certainly has been the dominant idea of the British navy in so far as its great line of battle ships are concerned—if, for example, a combination of immense speed with one or two extremely powerful and well-protected guns should serve a particular object better than a slower and more fully protected ship would serve it—then even great destructibility in the ship may justifiably be incurred. But for general naval service, and in every case where a ship is intended to accept battle with a powerful antagonist and fight it out; or to face an action, when she encounters such an enemy, it cannot be wise to have her so exposed, that an enemy may almost certainly sink her or cause her to capsize by merely pouring any kind of shot or shell into her unarmoured parts.

On the other hand, where ships are formed with fine water lines and the two opposite sides are consequently very near to each other for many feet, it is quite unnecessary to cover them with armour. The buoyancy comprised between the two sides at such parts is very small, and consequently penetration can let but little water into the ship and do but little harm. In the new British ships *Nile* and *Trafalgar*, which have excited great admiration in England, there are about stixy feet of length at each end left without armour; and as the ships have fine lines, but are nevertheless of considerable breadth at sixty feet from the ends it seems probable that good judgment has been shown by their designers in this matter.

But activity in regard to naval matters is not being left entirely to foreigners; or to those who are unconnected with the present ministry. It is said that the Government have adopted the policy advocated by Lord Charles Beresford in a confidential circular recently issued by him, in which he urged the necessity of at once building a fleet of fast cruisers of the *Thames* type. A number of such vessels are to be put in hand at once and the estimates for each year will be so framed as to cover the precise amount of work done. The Admiralty Board has determined that for the future no deficits shall be carried forward. Lord Charles has also devoted special attention to the New Naval Intelligence Department, and when it has got into full working order, there is no doubt but that it will be found equal in completeness and efficiency to the corresponding department in connection with the Army.

LIGHTING RAILWAY CARRIAGES WHILST THEY ARE PASSING THROUGH TUNNELS.

MR. THOMAS P. CARSWELL, of the Engineers' Department of the North British Railway, has invented what he calls an "Improved System of Electric Train Lighting." His object is to introduce a light into every compartment of every carriage as soon as it enters a tunnel, and put it out as soon as it emerges into daylight at the other end. In each compartment there must be an incandescent lamp, the positive poles of which are in connection with contact-pulleys under the carriages. The negative poles are connected with any metallic portion of the carriage, so that the current may find its way to earth by means of the axles, wheels, and rails. Between the ordinary rails is a third one extending throughout the tunnel. This rail is carried upon insulators; and upon it the contact-pulleys roll while the train is passing through the tunnel. Near one of the entrances to the latter is a house containing an engine and dynamo. The positive pole of the latter is connected with the central rail already described, and the negative one is connected with earth. As soon as a train is signalled, the engine is set going, and the central rail charged. As the carriages enter the tunnel, the current passes by means of the contact rollers, through the lamps which immediately become incandescent. On emerging from the tunnel, contact ceases, and the lamps go out. No mention is made of a secondary battery or accumulator being introduced into the circuit. It would seem however that this would be almost a necessity in practice; especially in view of the intermittent demand which there would otherwise be upon the dynamo. Mr. Carswell's system may perhaps be the best one for the particular circumstances which he has to deal with. But for lighting railway carriages by electricity under ordinary circumstances, it is a question whether it would not be better done by having an accumulator in each lamp with engines and dynamos at certain stations for recharging the accumulators of exhausted lamps. It was shown by Mr. J. F. Swan at the last meeting of the British Association, that there was no difficulty whatever in producing a lamp, of reasonable weight, and at moderate cost, containing an accumulator which could be charged to last say eight to ten hours at least. Such lamps could be easily substituted for the ordinary railway carriage lamps and could be changed from time to time just as they are. Let us hope that in some form or other, electricity will soon supersede oil lamps, for the latter are no more nor less than ineffectual relics of barbarism.

PROGRESSIVE PERSIA.

HIS HIGHNESS the Shah of Persia, it would appear, is doing everything in his power to encourage the development of the mineral resources of the vast dominions under his sway. He has, we understand, leased to some Armenian gentlemen of Ispahan a tract of country measuring 30 miles square and situate within 80 miles of the old capital. The lease is for 30 years subject to a *tithe* of the profits on all minerals mined and sold. There are several valuable seams of coal in this area varying in thickness from 10 to 18 feet and the mineral is said to be of a highly bituminous character. Besides coal there are other minerals such as limestone, sulphur iron, copper, quicksilver, slate of excellent quality and variety, and naphtha. At *Khonsar*, a place within a short distance of the *concession*, there are rich veins of galena containing a high percentage of silver. Coal is mined to a limited extent owing to the smallness of demand due to prohibitive prices which only suits princely pockets. The poorer classes cannot purchase it, and the middle class people can only afford to have it on special occasions, when there is a short supply of wood fuel. The cost of placing the coal on the bank is stated to range from Rs. 3 to 4 per ton and the transport charges vary under circumstances and according to season from Rs. 30 to 35 per ton. The mineral is sold at Teheran at from Rs. 50 to 54 per ton, and at Ispahan the prices fluctuate from Rs. 80 to 85 per ton. Camels are at present the chief and cheapest means of transport, each capable of carrying a load of 4 maunds. Quantities of coal are supplied to His Highness' Palace, Gas-works, and Arsenal, and to the foreign residents in and about the old and the new capital. The *concessionaires* intend improving the present means of carriage by introducing carts—drawn by horses or mules—of the carrying capacity of 1 to 1½ tons. This will considerably reduce the transit charges and place the coal within the reach of all.

We are glad to learn of this most enlightened step of the Persian Government and hope that it will still further add to the many wise and civilising measures which have of late characterised the reign of the present ruler—Nasuriddeen. Now that the ball of progress has been set rolling in the Land of the Sun and Lion, let us hope that in its onward progress it will equally benefit that vast country whose growth has been retarded by threatened insecurity from within and besetting dangers from without.

INDIAN ENGINEERING is the name of a new technical journa published in Calcutta. It is a well edited and valuable addi tion to technical literature, representing in an inteliigent and practical manner the engineering works and wants of that immense field for engineering—British India. Many of our American manufacturers will find it advantageous to consult and use its pages in extending their trade in that promising market, and our Engineers will find many items of interest to them in the references to works built, building, or to be built. The Scientific Publishing Company, 27, Park Place, New York, act as American Agents for INDIAN ENGINEERING.—*Engineering and Mining Journal*, New York, February 26.

THE *Pioneer* says: "From time to time we hear of Russian projects for a railway line from the Caspian to Teheran, but nothing definite seems to be known of the subject. We notice that the *Nouveau Temps* states that M. Polyakoff, well-known as an enterprising contractor in Russia, is now negotiating with the Persian Government for the construction of a line from Resht to Teheran. Engineers are said to have been sent specially from St. Petersburg to survey the railway route, and M. Bogatal, Director of the Persian Post and Telegraph Departments, is named as M. Polyakoff's agent at Teheran. We doubt if this new project will come to anything, as the Shah and his advisers have never really shown anxiety for the opening out of Persia by means of railways."

IN regard to the Port Arthur contract being given to the French, the *London and China Express* says, that one reason why it was successfully taken from English hands was that a guarantee for ten years was desired by the Chinese Government for the works after their completion, which the firm concerned was unwilling to give. The French syndicate have given this, and the Comptoir d'Escompte have guaranteed the guarantors.

Notes and Comments.

ADDITIONAL INSPECTORS OF LOCAL WORKS IN BENGAL.—We learn that Messrs. W. B. Christie and J. T. Simpson get the two newly created posts of Divisional Superintendent of Local Works in Bengal—the former getting "Burdwan with Orissa" and the latter "Chittagong."

THE BENGAL-NAGPUR RAILWAY TERMINAL JUNCTION.—The question of the point of meeting of the Bengal-Nagpur and East Indian Lines has been again revived. A consensus of opinion is in favour of the Asansol Junction, and certainly there is a great deal to support this view of the question.

THE BELLARY-GUNTACUL BRANCH RAILWAY.—Since the Madras Railway Company handed the line from Bellary to Guntacul Junction to the Southern Mahratta authorities, Mr. T. A. Cox, the Resident Engineer of the Southern Mahratta Railway Company, Bellary division, has been very busy with his staff in altering the broad into the narrow gauge.

E. I. R. BURRAKUR BRANCH EXTENSION.—We learn that Mr. G. F Beyts, Resident Engineer, is now engaged preparing the survey and estimates for the proposed extension of the E. I. Railway from the Burrakur to the important coal field on the other side of the river. The prospective advantages must be very great indeed to justify the comparatively heavy outlay, which will include a bridge about a third of a mile in length in a total distance of five miles. It is not contemplated to go beyond the Kudia river at present.

THE BENGAL CHIEF ENGINEERSHIP—AGAIN.—The possibility of another change in the Bengal Public Works Secretariat is now discussed. Should Colonel Brown, R. E., obtain, as is probable, his promotion to Major General in July next, he would as a consequence have to vacate his appointment in the Department—unless he can get a second *extra* Departmental step or become Chief-Engineer First Class. In the event of Colonel Brown's retirement, it is almost certain that he will be succeeded by Mr. Horace Bell.

S. P. SCANDAL.—The Director General Railways, Mr. Molesworth, and Mr. Williams have finished their sitting on the Sind Pishin line. The finding of the proceedings has not been made public, but it is rumoured that the expenditure has not much exceeded the estimate made six weeks before the Committee sat, and in fact the only divisions where the expenditure has been abnormal have been under Civil Engineers! All previous estimates being cancelled is a great score, and an explanation for the expenditure on the line rising from one hundred lacs to four hundred and twenty will no longer be required. "*Sic itur ad astra.*"

MAJOR GRACEY'S APPOINTMENT.—We remarked the other day there must be some mistake in the appointment of Major Gracey as "Chief Engineer" in Upper Burma. The *Gazette* notifies his appointment as "Superintending Engineer." There is much in a name or designation. It would be too patent to the world at large as a monstrous job to designate Major Gracey as "Chief Engineer." He is therefore called "Superintending Engineer"; but a dirty job is perpetrated all the same—only in a surreptitious way. Major Gracey is to get 500 rupees per mensem in addition to the substantive salary of his rank as Superintending Engineer. Sir Theodore Hope's administration of the P. W. D. has become a bye-word for favoritism and jobbery.

DOCK ACCOMMODATION IN BOMBAY.—Mr. Russell Aitken, a former Engineering member of the Bombay Harbour and Pilotage Board, writes to the *Times* anent Lord Brassey's complaint that large ships of war have to go from Bombay to Malta to be docked, that in India some system is wanted whereby public works should be openly discussed and considered before they are undertaken. At present both the Government and Municipalities are spending millions sterling on works, which would never have been begun if they had been examined in the same way as bills are examined in the Committees of the Houses of Parliament. And this view of the matter is supported by the early history of the Bombay Docks.

INDENTS FOR TIMBER BY THE PUBLIC WORKS DEPARTMENT.—The Government of India having had under consideration the desirability of the more extensive supply of timber by the Forest Department to State Railways, is pleased to empower Managers of open lines of State Railways to call for, and accept, tenders from the Forest Department, for the supply of wooden sleepers for two or three years in advance, subject to the restrictions that such advance orders should be confined to the quantities estimated to be necessary for normal or ordinary renewal requirements, and be only given in cases where there is no room for uncertainty as to the nature of the sleeper which will be required for such purposes.

MAJOR MARSHALL'S APPOINTMENT TO RAJPUTANA.—This is another job which must be credited to Sir Theodore Hope. Both the appointments in Burma and in Rajputana should have gone to senior and more deserving men on the Local Administrations' List. Several senior men are superseded, but the explanation offered is that they are only Civil Engineers! A Correspondent asks: "What are they doing? And is there not a Civil Engineers' Defence Committee? Are the Civil Engineers individually and the Committee collectively so weak-backed as to be unable to make head against such bare-faced dishonesty in the distribution of Government patronage? If they are they deserve all the contempt with which they clearly are treated."

THE NON-RECOGNITION OF GOVERNMENT ENGINEERS.—Colonel Salusbury Trevor's "reply" at the recent farewell dinner to which he was entertained in Calcutta by the Members of the Bengal Public Works Department contains the wholesome reminder that Engineers of the Public Works Department cannot hope to receive those distinctions or honours, which appear as a matter of course to fall to the lot of officers in other departmements of the public service, unless they have earned them by work independent of their own profession; and this, notwithstanding the fact that the result of Engineers' labours is almost the only tangible proof of the benefits which India has derived from British rule.

RAILWAY SERVANTS AND THEIR INVENTIONS.—As more than one invention of railway utility patented by Mr. Stoney, Resident Engineer, Madras Railway, has been used on that Company's system for years past, free of any patentee's fees, that officer has now applied, in consideration thereof, to his Board of Directors for a substantial honorarium, and we are glad to learn that his application has been supported by the Chief Engineer as well as the Agent and Manager. One of the most useful of Mr. Stoney's inventions is his patent self-acting interlocking points, which remove all chance of one class of accidents, *viz.*, derailments at stations. For the use of this

patent alone on Indian State Railways, Mr. Stoney received from Goverment an honorarium of Rs. 10,000.

BRITISH ENGINEERING IN EGYPT.—Colonel Lang declared in his recent address at the close of the Annual Session of "Roorkee" that even in Egypt there are two of its pupils among the small band of picked Engineers selected to implant the Indian system of irrigation in that old land of the Pharoahs and their canals. It has been well observed that if less has been done in the Egyptian Department of Public Works than might have been expected from the energy of Colonel Moncrieff, the fault here also lies with the bondholders, and the captious interference of the French. The water-supply, however, has been sensibly increased without additional cost to the cultivators, and other works must wait the convenience of an exhausted Treasury.

TALC IN PAPER.—It will interest those concerned with paper-making in India to learn that the very high and beautifully smooth glaze of American papers which has long been a source of admiration and wonder in this country, is attained, according to Professor Macadam, by the substitution of talc for China clay (kaolin) in its manufacture. Amongst other advantages of talc over China clay is that it gives a much more pure effluent, fully 90 per cent. being retained in the paper. From its fibrous nature it appears to attach itself to the smaller paper particles and retains these also, being thus more economic, while producing a paper of greater toughness and durability. The mineral is abundantly found in India, having a wide distribution throughout the metamorphic rocks which occupy so extended an area of the country.

GIGANTIC COTTON-MILL ENGINE.—Messrs. Douglas and Grant, Dunnikier Foundry, Kirkcaldy, have at present in hand a compound Corliss engine of a very large description for a cotton mill in Bombay. The high-pressure cylinder of this large engine is 40-inch diameter and the low-pressure cylinder 70-inch, each having a stroke of 6feet. The fly-wheel, which weighs about 110 tons, is 30feet in diameter by 8feet 6inch wide, grooved for 38 ropes, by which the power is to be transmitted to the various lines of shafting in the mill. The engine is to run at 60 revolutions per minute, giving a speed of ropes of considerably over one mile per minute. The crank shaft, made of Whitworth fluid compressed steel, is 25 inches in diameter in the body and 20 in the bearings. The steam pressure is to be 100lbs per square inch, and the engines will work easily up to 2,500 horse-power.

FOREST ADMINISTRATION IN THE BOMBAY PRESIDENCY.—A Government resolution on the Forest Administration reports of the N., S., and Sind Circles, 1885-86 says ;—The year under review was in many ways an important one in the history of Forest Administration in the Bombay presidency. The revenue was the largest on record. Material progress was made in the demarcation and settlement of the forests; and a special Working Plans branch of the Department was established. The large increase of revenue is due in great measure to the great demand for sleepers for the Railways of the Southern Maratha Couutry from the Kanara forests, but is also due to causes it may be hoped more general and permanent, of which there is indication in the higher prices obtained for timber in the auction sales of the Southern Circle and in the growth of a large export trade of fire-wood from Sind.

ROORKEE ALUMNI.—Colonel Lang, R.E., Chief Engineer, Public Works Department, declares that during the ten years which have elapsed since he left the Thomason College, he has served in many parts of India widely remote one from another, including indeed both Beluchistan and Burma: but everywhere he has found amongst the Public Works employés in every grade old alumni of this College, many of them his own pupils. He found them everywhere holding their own with Royal Engineers, Stanley, and Cooper's Hill men: and everywhere they are to be found among those holding the highest posts. In the North-West Provinces all three of the Superintening Engineers in the Buildings and Roads Branch gained their engineering education in this College: one of his Superintending Engineers in Burma was a Roorkee man: and everywhere in every province many of the most important divisions and works are in the hands of former students of this College.

FRONTIER RAILWAYS EXTENSION.—The Director General of Railways and Mr. Molesworth passed down the Bolan Line on the 6th instant and examined the plans and estimates and the alignment for the broad gauge line between Hirok and the Kotul. Several schemes have been proposed and surveyed—each of which has its ardent supporters. By the latest account the project for the Abt system has been pigeon-holed. Nobody seems to care much, however, and those whose services are being retained for this work continue drawing their salaries in comfort while events are ripening It would be both instructive and amusing to know what sums are laid out by Government in matters of this kind, if it were not that we all have to contribute towards these extravangacies in the shape of income tax. It is hoped, however, that work will now soon be started in earnest as the inconvienence and inefficiency of the metre gauge to carry the traffic are becoming more felt every day.

THE LATE MR. W. H. JONES OF PERAK, STRAITS SETTLEMENTS.—We regret to record the death of Mr. W. H. Jones, who was for over 6 years connected with the State of Perak in charge of the State Railway as Traffic Manager and Resident Engineer. He had a sound knowledge of his profession, was a zealous officer of the State, and fell a victim to his zeal and energy. He was continually obliged to give his attention to out-door work, which in Perak means working in swampy jungles, full of poisonous gases in low grounds, and cursed with the prevalence of venomous creeping insects. This sort of work must have told on Mr. Jones, and he succumbed under it on the 12th ultimo. He died in the Eastern Hotel, Penang; and through the courtesy of the Resident Councillor in Penang, his remains were brought over to Perak in a Government launch, and buried with masonic honours in Larut. He was an A. M. I. C. E. He died at the age of 33. Mr. G. A. Lefroy, District Engineer of Larut, is at present in charge of the Railway.

THE CALCUTTA CHAMBER OF COMMERCE "REPRESENTATION."—The mercantile community of Calcutta deprecate the possible substitution of native agency for European in the charge of important executive posts in the country. The Chamber of Commerce is the mouthpiece of that community, and represents the interest of a foreign trade aggregating £64,000,000 per annum and a coasting trade of nearly £10,000,000. This trade has reached its present volume from a total for all India of 18½ millions in 1839 mainly through British enterprise and capital. In addition, there is an enormous amount of British capital sunk in this country in the tea, silk, indigo and

jute industries, and in railways, mills and manufactories, and India has in consequence become one of the foremost competitors in the markets of the world. The mercantile community may almost be said to rival the Government as employers of native labour, and their position forbids the intrusion of any other consideration in the selection of employés than efficiency and economy. The result of their experience in all sorts of undertakings is that European supervision (costly though it be) is an essential element of success in this country.

THE KIDDERPORE DOCKS.—The foundations of the Quay walls are now being rapidly pushed on so as to be completed in great part before June next, leaving the upper portions to be completed during the rains. The Dock wall is founded 48 feet below present ground level, and at the bottom is 35 feet broad. As it rises it is reduced in thickness by off-sets behind, and at the top measures only 13 feet, the width required to carry the cranes that will be used in the loading and discharging of vessels in the dock. The wall is built with hollow compartments to reduce the mass of brickwork, and is pierced at the top by a tunnel about 5 feet broad and 6 feet high to be carried round the dock, and in which will be laid all the hydraulic piping required for the working of the cranes, the water pipes, and gas pipes. The soil has turned out much more favourable than was anticipated. Tramways have now been completed all round the works. A railway to Akra for the conveyance of bricks and soorkey has been laid; and as lime from Burrakur can now be delivered by railway *via* the new "Jubilee" bridge, the whole of the material will be conveyed direct from the brick-fields and the lime kiln to the points at which they are to be used without breaking bulk, or its being necessary to employ a single cart.

THE RAWALPINDI WATERWORKS.—The Rawalpindi Waterworks were opened by Sir Charles Aitchison on the 26th ultimo. This project was prepared by the Public Works Department and handed over to the Municipality to carry into effect. The source of supply is a point on the Kurrang river, near Rawal, about nine miles from Pindi on the Murree road. The quantity of water required will be obtained entirely by gravitation, and is to be drawn from three wells on the right bank of the river; one of which is actually sunk in the river bed, and the others in the low-lying water-bearing basin adjoining. These three wells are connected and from the centre one the water is first conducted for some 2,000 feet, through 12 inch pipes, to a junction tank, from which place it will again be carried for seven miles into Rawal Pindi by means of a concrete aqueduct. The last mile is widened out, so as to practically form a service reservoir, and terminates in the northern suburbs of the city in an inlet well or tank 15 feet in diameter; the water in this tank being some 7 feet above the ground level. As a temporary arrangement, it is proposed to lay down a short length of piping, and set up half-a-dozen hydrants from which the water can be carried into the city. The population of Rawal Pindi is estimated at 30,000 people, and it is anticipated that the daily supply brought in will, if required, be equal to 20 gallons per head. The cost of the work, as far as carried out, was estimated at some 21 lakhs of rupees. The greater part of the money needed has been obtained by means of local loans, to be repaid in a comparatively short term of years.

Current News.

A PRELIMINARY survey for a Railway between Bahraich and Sitapore has been sanctioned.

A WATER-SUPPLY scheme for Quetta has been considered, and, a correspondent hopes, finally settled.

THE price of timber in Moulmein has gone down, and several speculators have suffered great losses.

ON Thursday before last a fire broke out at the City Cotton Press, Indore, which was completely burnt down.

THE opening of the Ferozepur Bridge, which was to have taken place on the 20th instant, has been postponed.

THE announcement lately made that sanction had been accorded to the construction of the Chittagong railway is premature.

TELEGRAPH lines to Manipore *via* Kohima, and to Shenno, *via* Mandalay, were opened—the former on the 31st March, the latter on the 1st instant.

FOR the first time the Ranikhet cart-road has been used this spring by troops marching into the hills. The road is not yet finished, but carts can now traverse it for come distance.

MAJOR A. D. MCARTHUR, R.E., Executive Engineer, 1st grade, and Under-Secretary to the Government of Bengal, Public Works Department, is expected to return from leave about the 24th instant.

THERE is a great field on the Irrawaddy for a steam launch service between stations. The Flotilla now have a fine line of large steamers on the river, but very many small places are comparatively neglected.

ONE of the tasks Sir Theodore Hope will have to conclude, before he lays down the portfolio of Public Works Minister, will be to report on the enquiry now being held on the expenditure of the Sind-Peshin State Railway.

ACCORDING to the latest information the Russian Trans-Caspian Railway is being pushed on most vigorously, and it is expected the line will be completed from the Oxus to Bokhara and Samarkhand by the end of the present year.

SOME advance has, we hear, been now made in the matter of a drainage scheme for Coonoor on the Nilgiris, which is estimated to cost Rs. 40,000, and which has received the approval of Government in the Public Works Department.

MR. W. H. Jobbins, the newly appointed Superintendent of the Art School of Calcutta, under the re-organisation scheme, has had very large experience both as a teacher of Art in England, and as a student in Italy. He has likewise shown some very good works in the Royal Academy.

COLONEL SWETENHAM, Major Corbett, Mr. A. Grant, and Mr. W. C. Wright in giving evidence before the Public Service Commission at Allahabad, deprecated the difference in the rules as regards men from Cooper's Hill and Roorkee. Mr. Tupp takes the place of Colonel Lang on the Commission.

A PLAN suited to the condition of Ahmedabad for removing the sulliage water now thrown in the streets, has been sanctioned, which if improved, after a time, according to the suggestions made by Sir Theodore Hope in paragraph 17 of his Memorandum, will efficiently clean the city of its dirty water.

A GLANCE at the classified list of the Madras Public Works Department will show that Mr. Target, a Goverment of India Executive Engineer, 1st grade, had to serve under Major L. Campbell, his junior in that grade, because, as an outsider, Mr. Target had no claims to the plums of the Madras Public Works Department.

THE Mandalay line is being pushed on rapidly, and the rails are said to be laid down now at the rate of half a mile a day between Toungoo and Nyingyan: at this rate of proceeding, if it is kept up, the line to Nyingyan should be opened before the rains, and should greatly assist in keeping that district quiet during the south-west monsoon.

A FAREWELL dinner was given on Saturday the 9th instant, to Colonel S. Trevor, Royal Engineers, by the officers of the Bengal Public Works Department, as an expression of the warm feelings entertained by all the Department for their guest, who has for $3\frac{1}{2}$ years been at its head, who has always had its interests at heart, and who is now leaving India probably never to return.

Mr. Hickman, Assistant Engineer at Dehra Ghazi Khan, was unfortunately bitten by a *krait*, while out on a shooting excursion. The latest intelligence received was to the effect, that he was in a critical condition, though, as two days had elapsed since the occurrence, there was hope of his recovery. The hand which was bitten had, we believe, been immediately cut off to prevent the poison from spreading.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

RIVER PROTECTION WORKS.

SIR,—The difficulties referred to by Mr. Cox are somewhat enhanced by obscurity of description. For instance, foundation works of piers situated mid stream are required to be protected by temporary *bunds* running out from the river bank. This require-

ment is somewhat mysterious, particularly if the river be wide and in that case the necessity for giving the *bund* a direction different from the shortest is equally less clear. If the piers are, like abutments, in or near the banks, then the pertinence of the latter course can be understood, and, in connection with the same, I would suggest that the *bund* be made to play the part of a spur or groin, accordingly located a short distance up stream above the sites of the piers or pier. It is a fundamental principle in works of this class that water should be assisted and not resisted. Hence the direction of the diverting barrier is generally placed askew to that of the stream, the amount of skew varying with the velocity of the current. I have seen them thrown out at angles ranging from 120 to 150 degrees and the deflection produced thereby has been known to impinge or cause a set against the opposite bank some distance down.

As to the consideration of the *construction* of *bunds*, they will of course depend upon materials available. In this particular case, if logs are procurable, partition casing might be made block-hut fashion and the intermediate spaces filled in with loose material. Scrap rails would serve the same purpose. Failing either, sand bags or gunnies or gabions might be turned to account in securing the desideratum.

HYDRO-DYNAMICS.

RAILWAY PROBLEMS.

SIR,—Railway fares and rates are now occupying the serious attention of English travelling and trading public and strenuous attempts are being made to bring about a general reduction to suit the times which are not so prosperous as they were some years ago Depression of trade has led to a considerable mischief in manufacturing and industrial centres, where of late there has been undesirable results arising from the clashing of opposed interests. In this country we find an analogy between the fare and rate paying public and the various Railway Companies, more particularly those whose interests cannot be affected by rival undertakings. It is this circumstance, coupled with the arbitrary conduct which characterises the action of some of the Companies—particularly the East Indian Railway—that has hitherto precluded the possibility of any good coming from protestation or representation—combined action —on the part of the affected public. I think Government interference imperative towards effecting a considerable reduction of fares for both up and down country traffic. It is absurd that we should have to pay so much as we now do for coal sent by rail.

Now that the coal from Umaria is playing an important part in the Upper Provinces and is gradually but surely and sensibly encroaching upon the limits heretofore appropriated to or claimed by the Raneegunge and Karharbari coals, there should be a careful revision of the tariff and the rates so regulated as to compensate the unfavorable competition on the part of the new field just named. This could be done by a fair reduction in the fares for *down* coun try coal, the traffic in which is annually increasing, and now that the Jubilee Bridge offers an easy means of crossing the Hooghly and its opening will ensure a larger field for the use and application of that mineral, it is but reasonable to expect that there should be a concession in the mineral rates for both Howrah and Eastern Bengal. The loss thus occasioned will be more than made up for by the increased traffic which will flow down country as the result of equalisation or abatement of rates.

ECONOMIST.

DEPARTMENTAL GRIEVANCES.

I

SIR,—Would you kindly oblige and publish the remarks subjoined on the recent appointments to the higher posts in the D. P. W.

It is iniquitous the way Royal Engineers are rushed up, and Civil Engineers passed over. As soon as a Civil Engineer attains to some standing and position everything is done to harrass, worry and disgust him out of the service, so though the Department is forty years old (since its constitution into a Department) there is not a single Civil Engineer filling the higher administrative posts—they have all chucked up in disgust at repeated supersessions.

I write under a sense of anger and indignation, and with justice, for to look at the recent array of jobs perpetrated in the Local Administrations' Lists for the past 5 years it will be seen that the senior Engineers in it have just cause for complaint :—

In 1881. Mr. Furnivall from the Railway list was brought into the Local Administration List as Chief Engineer. Colonel Mayne was also brought in from a foreign list.

In 1882. Colonel Cumming from one of the Under-Secretaryships to Government of India was brought in as Superintending Engineer. Colonel Moncrieff was brought in as Chief Engineer, from N. W. Provinces Irrigation.

In 1883. Colonels Lang and Ward were brought in as Chief Engineers from the Military Works list.

In 1886. Mr. Mathews was brought in as Chief Engineer from the Railway list.

In 1886. Colonels Ward and Browne, were brought in as Chief Engineers, from the Military Works list.

In 1887. Majors Marshall and Gracey, are brought in as Superintending Engineers, from Government Secretariat and Railways respectively.

All these vacancies should in common honesty, and in accordance with the principle (Heaven save the mark !) on which Government *profess* to act,—all the vacancies, I say, should have gone to the senior men on the list in which they occurred. But then how would the pet R. Es. have been provided for ! If you can exert your influence in bringing about more even-handed justice, I need not say you will be working a boon to a large class of Civil Engineers. I am afraid a great many Civil Engineers are a poor lot—good at work—but in slavish fear of their Masters the Royal Engineers. Those who are not, become marked men, and so matters go on—the plums for the R. Es. and the work and kicks for the C. Es. ! I could go on to the end of the chapter, but must stop.

A VICTIM.

II.

SIR,—The last *Calcutta Gazette* was more than an eye opener for some of us, as we noticed that Mr. Bestic was promoted over the heads of no less than eleven of us to be Executive Engineer 4th grade sub. *pro. tem.*

Since Mr. Horn was transferred to Buxar in July last, Mr. Bestic has been carrying on the duties of the Under Secretary in the *appointment branch* of the Public Works, under Col. Trevor, who is about to leave for England. Mr. Bestic may or may not be a very able Engineer, but never having been in charge of any works, excepting for two and a half months when he held temporary charge of the Darjeeling Division, he has not had an opportunity of distinguishing himself.

He has had seven and a half years' service, but strange to say he has not yet held independent charge of a sub-division.

He was first posted to Dacca, and there put in charge of the Executive Engineer's Office, as a personal assistant.

He continued to attend to the office duties until he was transferred to Darjeeling for two and a half months as a temporary measure. It is true while in Dacca he did hold one sub-division for a few months in conjunction with a competent and able supervisor who drew sub-divisional allowance during the whole of the time. This was to enable him to learn other than the office work on which he was regularly employed.

Thus Mr. Bestic has had little if any practical experience, but his present promotion will put him over the heads of men of proved ability in administering sub-divisions and divisions and carrying out large works.

Not only were eleven more or less promising and rising Engineers (not quill drivers) superseded but, strange to say, in order to create the vacancy in the sub *pro. tem.* grade one Krith Chunder Chowdhry, a man on furlough since July last and still on leave, was reduced to the temporary grade. Krith Chunder Chowdhry's reduction was antedated to September last, so supposing he was not reduced in order to create a vacancy, such delay in gazetting the reduction alone is sufficient commentary on the manner in which the appointment work has been carried on since it has passed through Mr. Bestic's hands.

THE DISAFFECTED.

Literary Notices.

TWENTY YEARS WITH THE INDICATOR. *By Thomas Spray, Jr., C.E., M.E,* Vols. I. and II. New York : John Wiley and Sons.

The subject matter of these books has been gathered, the author says, from probably " the broadest experience ever enjoyed or earned by any man" in the Union. This is further explained by the declaration that " the work has been compiled from one of the most extensive practices any man was ever engaged in, at a time. too, when the author has been not only busy, but a very busy man. The purport of the volumes before us was contributed to certain trade journals in the United States, whence the author was induced to abstract the matter and offer it in its present enlarged and much modified form. Volume I., however, is in its second edition, which appears at the same time as Volume II. Notwithstanding the author's disposition to " blow " and indulge in occasional " loud talk, " the lessons in the book, being drawn from actual practice, have a value peculiarly their own. The aim has been to convey knowledge to the greatest extent possible, and in such a way that the working engineer and the men who use engines shall understand and be able to work out the results of an appliance that has revolutionised the theory of working steam. Everything is put in the plainest wording, so as to avoid misunderstanding on the part of those for whom the book is intended. Mathematical formulæ are absolutely avoided, the general character of the work being practical and instructive, and at the same time a vindicator of that once much abused, much misunderstood, and yet so simple an instrument—the steam-engine *indicator*. Both volumes afford a fund of information which cannot fail to prove beneficial to working engineers everywhere.

General Articles.

RANGOON POST AND TELEGRAPH OFFICE.

THIS building was designed by Mr. G. S. T. Harris, Executive Engineer, under the directions of Mr. W. C. Furnival, M.I.C.E., Chief Engineer of Burmah. It is 60 feet high and of three storeys, the ground floor being occupied by the Post Office, the first floor by the Telegraph Office, and the second floor is used as a tenement by the employés of the Post and Telegraph Departments.

The building is situated on the Strand, between the Government Secretariat Offices and the Bank of Bengal, and presents a clear frontage to the river. It is entirely of iron in its skeleton, the body being filled in with single brick wall, and the whole stands on a mass of concrete three feet thick.

There is a central well 32 feet square within the building affording light and ventilation to the interior rooms, roofed in with glass on light W. I. trusses. The ground floor of this will form part of the hall 32 feet × 48 feet, in which the public do their postal business. There are in addition two front verandahs 40 feet × 10 feet for purposes of enquiry, &c.

The first and second floors consist of concrete arches on rolled joists, and the roof is of concrete on 12-inch square tiles carried on ⊥ iron joists. The ground and first floors, that is the floors of the Post and Telegraph Offices, are paved with Minton tiles; the floors of the dwelling rooms on second floor are of cement polished to a fine surface; and the roof is coated with asphalte. All the office and dwelling rooms are ceiled.

Necessary auxiliary accommodation is provided in outhouses of brickwork, for Post and Telegraph delivery peons and servants, latrines, cook-houses, coach-house and stables.

The main building cost Rs. 2,99,174, and, inclusive of auxiliary accommodation, the total cost of scheme amounted to Rs. 3,51,613.

THE GANGES BRIDGE AT BENARES.

THE bridge over the Ganges at Benares now being constructed by the Oude and Rohilkund Railway Company will form a most important link between the railways in Oude and the North-Western Provinces and the East Indian Railway. On its completion Lucknow will be in direct Railway communication with Calcutta by a route 52 miles shorter than that *viâ* Cawnpore. Places north of Lucknow will all participate in this advantage, and places lying between Lucknow and Benares will derive even greater benefit.

The junction with the East Indian Railway at Mogul Serai will give the nearest route to the Punjab *viâ* the Company's new Northern Extension joining in with the North-Western Railway at Saharunpore.

The bridge consists of 16 spans, *viz.*, 7 of 356 feet and 9 of 114 feet, measuring from centre to centre of piers. The larger spans extend from the north bank over the river, and the smaller spans are flood openings in case of overflow of the river on the south bank. The total length of the bridge from end to end of girders is 3,523 feet. The piers of the larger spans are founded on elliptical wells 65 feet by 28 feet, and in each well there are three openings to admit of the necessary excavation in sinking. Those piers which are in the river were started in water varying in depth from 10 to 30 feet, and necessitated the use of hollow wrought-iron caissons, three of these being 10 feet in height, two of 26 feet, one of 42 feet and one of 50 feet. These caissons were built between a pair of pontoons coupled together, and lowered from them into the water when 10 feet in height—additional height and weight being gradually added in order to overcome their buoyancy and sink them on to the bed of the river.

The caissons were then released from their lowering and guiding chains, and masons were sent down inside to fill up the caissons with brickwork. This brickwork was carried up to some 10 or 12 feet above the water-level, and the pier was then ready for sinking to commence. The sinking was done by Bruce's dredgers worked by cranes travelling on the top of a timber staging built up to a height of 57 feet above the deck of the pontoons—one dredger and crane travelling over each of the three openings in the pier. These cranes were capable of lifting 20 tons each, and weigh themselves over 40 tons each. The diggers are of 8 feet diameter weighing when empty 3½ tons and containing 135 cubic feet of earth. Ordinarily the diggers were worked at night by electric light—the pier sinking each night about 2 feet, and the brickwork was built up a corresponding height during the day. No. 4 pier was sunk to 140 feet below low water in 176 working days including the time occupied in building. It was at first intended that all the piers should be sunk to a depth of 140 feet below low water-level, but owing to the hard bed of clay met with on the north bank the first three piers are sunk to a depth of 48, 62, and 70 feet below water—their base being 15 feet into the clay. The next two piers are sunk 140 feet, and those beyond them to 121 and 133 feet—these piers having passed through strata of *kunkur* and clay into yellow sand. This depth is necessitated by the soft nature of the river bed where the scour is often excessive owing to the violence of the current, which during flood attains a velocity of 12 miles an hour—the rise from low water to high flood level being 50 feet.

The wells having been sunk to the depths decided upon were filled up solid with concrete lowered down in self-acting skips; a stone coping was then built on top, and the pier was ready for its superstructure. This consists of an ellipse, 62 feet by 25 feet at base, and tapering up 1 in 50 for 50 feet built in solid brickwork and having a heavy moulded stone cap on top. The height of the pier above low water-level is 72 feet 7 inches, and the total height from the cutting edge of the caissons of the deepest piers to top of girders is 252 feet.

The piers of the smaller spans are each founded on two circular wells 12 feet 6 inches in diameter pitched 25 feet centre to centre and varying in depth from 63 to 152 feet below ground level.

Both abutments are founded without well foundations—that at the south end having long wing walls giving access to the bridge by a flight of steps on each side. On these abutments block houses will be constructed for the military defence of the bridge.

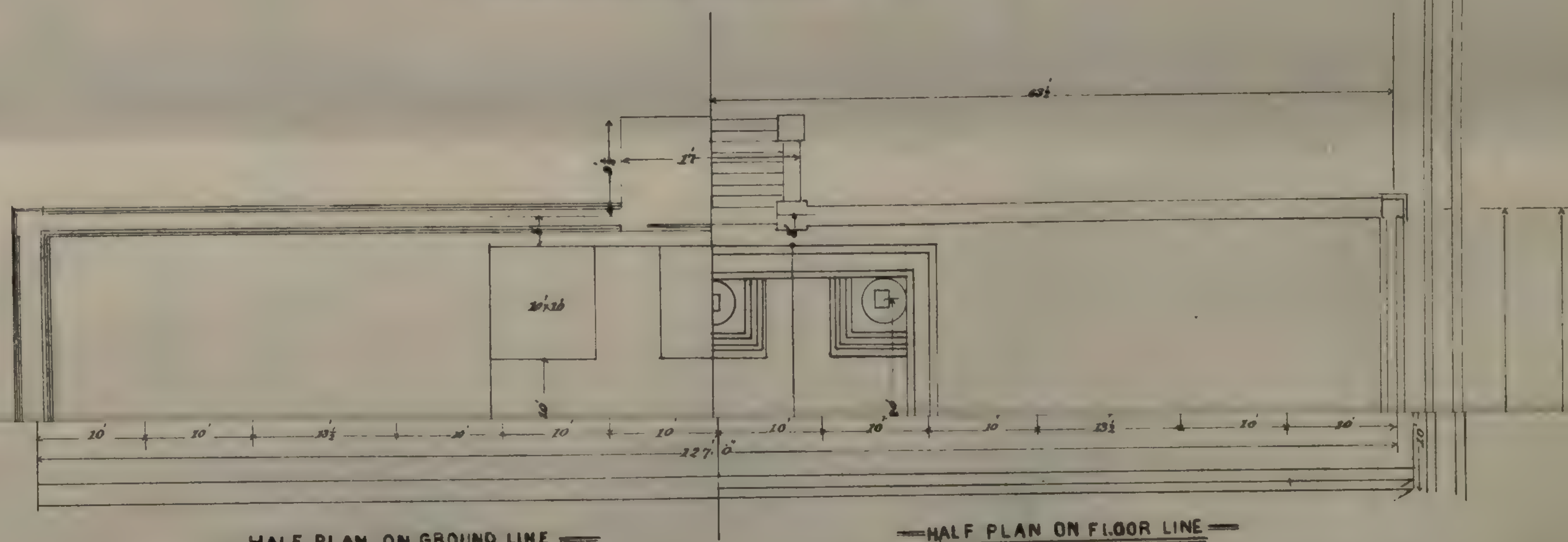
The weight of the material used in one of the deep piers is about 16,000 tons. This enormous weight has with the exception of the iron caisson and stone cap been carried into place on coolies' heads along a narrow floating staging leading to each pier.

No. 4 pier will be remembered for the serious accident that occurred to it in April 1883. During the process of sinking the well encountered a layer of clay sufficiently strong to stop the sinking. Holes were excavated in and through this clay by the continuous working of the diggers to a depth of 15 feet below curb, when the clay at one point suddenly gave way, and a vast inrush of sand from above the clay filled in the well to a height of 30 feet. The water inside being displaced by the sand rose over the top of the brickwork, then 21 feet above water-level in the river. The hydrostatic pressure was too great for the comparatively fresh masonry to stand, and the consequence was that one-third of the pier was burst outwards to a depth of 38 feet below low water, and 12 feet below the river bed—the weight of the brickwork displaced was about 500 tons—being about 60 feet in height, 46 feet in length and 5 feet in thickness. This mass of brickwork did not fall away at once, but after the floods of that year it was found to have been pushed out by the force of the current and was never afterwards discovered. The pier was restored by slipping on to the existing brickwork a double envelope of ½ inch iron suitably strengthened and tied with angle and T irons, and of the same shape as the fallen piece, lapping over the sound masonry wherever in contact with it. This was sunk down below the river bed to the base of the fracture

Indian Engineering.

POST & TELEGRAPH OFFICES
RANGOON

Foundation of Post and Telegraph Office



Strand Road

Scale of Feet.

1 3 6 9 12 15 18 21 24 27 30 33 FT

(Sd.) Geo. Harris.
Offg. Executive Engineer,
Special Buildings Division.

until it was entirely closed. The envelope was then cleared of sand and filled with cement concrete and further secured to the original brickwork by a bonding of rails. The pier was afterwards sunk a depth of 69 feet further—the top of the shield or envelope being now 70 feet below low water.

The weight of iron in the shield was about 25 tons.

In consequence of this accident all brickwork in the steining of the pier wells was afterwards thickened considerably by corbelling inwards and was built in cement.

It may here be mentioned that the caissons in piers were connected to the upper brickwork by a grating of 24 vertical angle irons, 3 inch × 3 inch × $\frac{3}{8}$ inch, with a horizontal bonding ring of the same angle every 8·1½ inch in height; this grating being carried up to the top of the pier well. The total weight of wrought-iron, including their cast steel cutting edges used in the caissons and grating is 909 tons.

The girders are lattice built and are entirely of steel, the total weight of steel used in the 16 spans being 6,405 tons.

The girders were supplied by the Patent Shaft and Axle-tree Co., Wednesbury.

The main spans are the longest yet constructed in India without the use of the cantilever form of girders, and the foundations of some of the main piers are the deepest in the world.

The girders of the main spans are 35 feet in depth, 25 feet apart centre to centre. The traffic will be carried between the girders of the main spans and on the top of the girders of the smaller spans, the road and rail being at the same level, with footways on either side on cantilevers outside the main girders.

The girders of the smaller spans are being utilised for erecting the main girders. Their length being one-third that of the main girders it requires three of the smaller girders to carry one of the larger, and therefore by erecting two temporary piers one of the main openings is spanned by three smaller girders.

These temporary piers consist of 6-inch solid wrought-iron screw piles with bases 3 feet 6 inches diameter sunk into the bed of the river and braced together, 12 piles forming each pier giving a base of 30 feet × 20 feet. The land span girders are then hoisted or floated on to these piers, and on them is constructed a timber platform 55 feet wide on which travel Goliath cranes, weighing 70 tons and lifting 15; and gantries for carrying rivetting machines, the rivetting being almost entirely done by hydraulic power on Tweddell's system.

During the season 1885-86, four of the main spans were erected, and these were completed as regards flooring plates and wind bracing during last rains. The three remaining spans which are in the deepest channel are now in course of erection. The staging to carry the main girders has been constructed in water varying in depth from 50 to 60 feet necessitating the making up of the river bed round the temporary piers in order to give them stability. In some cases the ground has been made up 43 feet in height above the river bed. This is done by first forming a wall of sand bags on the upper and lower sides of the line of temporary piers and filling in with sand between these walls until a wide platform of sand is ready for the reception of the screw piles. The piles are then screwed through the made ground on to the more solid bed, and the pier is afterwards further supported by piling bags round and pouring sand inisde through a 12-inch pipe lowered down sufficiently far to ensure the sand depositing where required. This support is brought up to where the bracing on the piles commences.

This temporary staging is in some cases over 126 feet in height, and it is estimated that each of its piers carries about 500 tons. The staging has not only to be constructed, but has also to be removed in each working season.

Work is carried on by day and night except during the very cold weather. The Gulcher system of electric lighting is in use and has worked most satisfactorily. It may be confidently stated that without the assistance of electric light the bridge could not have been built, simply because it would be impossible without continuous night work during the busy time to get through such work as must be completed to render the structure safe from flood during each season.

At date the temporary staging is completed over the three spans now erecting, and the main girders on two of these are finished. The erection of the third and last span is now beginning.

The first brick of this bridge was laid on 19th January 1882 and it is expected to be ready for traffic in October 1887.

F. T. G. W

THE LAND QUESTION.

THERE is a tide in the affairs of men which sometimes sets strongly in the direction of some political question and then, with a sudden bend, leaves that question high and dry. Thus a short time ago disestablishment was a prominent subject among ardent reformers. To-day it is left high and dry and around the land question the great forces are moving. On the land question as on all other political questions there is a Tory party and a Radical party. But this Journal will not busy itself to advocate the views of either—its object is only to get at the real facts and to leave party measures to party organisations and to party interests to further.

By way of understanding the land question let us put to ourselves the simplest conceivable case. Any elements of difficulty which this case comports will certainly reappear in an aggravated form in cases which are less simple.

The ordinary unscientific English politician usually endeavours to handle a new problem in its actual complicated form. Some of the elements in the case thus presented are elements fundamental to the problem. But other elements are conventional or accidental. As he does not distinguish one of these two groups of elements from the other group, it would be little short of a miracle if his legislation was anything but illogical and evanescent.

The Irish land question is the great problem at present before the English people and the English Government. Although similar difficulties may be felt by-and-bye in other parts of the United Kingdom we may here confine ourselves entirely to the case as now presented in Ireland.

Let us suppose that the owner of a tract of land in Ireland bequeaths his land to a relative who, in like manner, bequeaths it to another relative, and so on. The succession of these owners will give us one interest—say the landlord interest. Let the tenant bequeath to a relative, or make over without payment to a friend, such interests as he may possess and be able to dispose of. If the new tenant does likewise we have in this succession of men an interest called the tenant interest. The case is the same between these two groups of men as if one landlord and his one tenant could live for several centuries. At the beginning of this period let the land be wholly unimproved and let its rent treated as prairie land be £20 a year. Let the rent be supposed estimated in modern currency, so that we have no changes in the value of the currency to complicate the question before us. Let us also suppose that the landlord, tenant and neighbours all agree that £20 is a "fair" rent.

Then we shall see that this rent must in course of time repeatedly be altered if it is always to be a fair rent. In the first place the mere increase of population at home and abroad—with the growth of manufactures, *i.e.*, of groups of men who do not labour in agriculture, but must still be fed by it,—will raise the market value of country produce. Whether to the Irish tenant this change brings good or brings evil depends partly on himself. If the peasant of Belgium is more skilful and industrious—

if the soil there is more fertile and means of transport sufficiently improved, it may happen that Belgium country produce is sold in Ireland more cheaply than the Irish peasant is producing it. But let us suppose that the Irish peasant is fully able to hold his own ground against imports from Belgium or elsewhere. Let the increased value of the yield of the land we are studying be £10. Then if the rent remains £20 the increase goes wholly into the pockets of the tenant. If the rent is raised to £30 the tenant neither gains nor loses and the whole profit goes into the pockets of the landlord. It is difficult to see what right the landlord has to wealth which he had no part in producing. It is however equally difficult to see what right the tenant has to it. If a landtax was imposed to the amount of £10 on this particular land—the rent remaining at £20—and if this tax were spent on objects of national utility—the nation at large would absorb the increased value of the national soil. If the rent was raised to £25—no land tax being imposed—landlord and tenant would share the windfall between them. If any attempt were made to provide by legislation for absorbing such incidental increments of value in the general resources of the nation, landlord and tenant would for once combine and would throw out the proposed legislation.

As the land generally rises in value by the general growth of population so it obtains special increase of value if a town springs up in its immediate vicinity, or if a railway station is built in the neighbourhood. Let us suppose that some such event happens to our piece of land and let the special extra rent it is thus made worth be £15. Then, as before, the landlord may appropriate the whole or the tenant may appropriate the whole or they may share the windfall between them. And, as before, the increment of value really belongs neither to landlord nor tenant, but rather to the people at large.

Thirdly, the value of the land may be improved by actual labour expended on it. Thus subsoil drainage may be introduced or fences be constructed or farm houses built, or costly manure may be imported and applied. If these things are done at the sole expense of the tenant the landlord has no right to add a penny to the rent. If they are done at the sole expense of the landlord he has a right to exact their full equevalent. If, as is usual, these improvements are done partly by the landlord and partly by the tenant the rent should be adjusted accordingly.

We see, therefore, that even in the simplest conceivable case of one series of landlords who inherit without purchase and one series of tenants who inherit without purchase, there are still several causes continually at work tending to alter the value of the land and to make what is a fair rent for one series of years become an unfair rent for another series of years. The actual increments of value as due to growth of population, means of communication, improvements in agriculture, and so on, are not easy to specify. Unusual knowledge and unusual ability would be required to give even approximate figures for any particular estate. In five cases out of six the landlord would be incompetent to appraise them and in nineteen cases out of twenty the tenant would be similarly incompetent. Practically there would be a constant struggle between the landlord and tenant—each striving to retain as much as his labours or investments gave him full right to retain; and each striving to seize as much as possible of what we have called the incidental increments or the windfalls.

We began by assuming that for a given tract of prairie land a certain fair rent could be fixed. But what constitutes a fair rent? If the tenant is extremely skilful and industrious and asks for few comforts the "fair" rent will be a high one. If the tenant is idle, unskilful and fond of strong drink and general indulgence the fair rent as fixed by him will be extremely low. Let us suppose a tenant moderately skilful, but highly sober and industrious—to how much comfort and luxury is he entitled? The man that can answer this question can also state what sum would be a fair rent for a given piece of prairie land. If the landlord has one scale of industry and comfort which he thinks proper and sufficient for his tenantry, but the tenantry have other and quite different scales of labour and comfort which they consider respectively just and attainable, it is clear that their two ideas of what constitutes a fair rent will differ very greatly.

In all the foregoing discussion we have omitted that additional element of complexity which is introduced when the land has lately been bought by its present landlord. In this case some of the improvements were made by previous landlords. Some others were made by previous tenants. The records of these improvements may have been lost. Neither the present landlord nor the present tenant has perhaps any idea under what conditions these improvements were made. The new landlord and the new tenant must therefore take the facts as they find them. Admitting that they can come to a tolerably fair arrangement as to the proper rent for the next few years it will be impossible to prevent new changes taking place in the value of the land for the continuance of the causes above described. The fact is that private property in land is itself an anomaly and out of this root-anomaly must other anomalies spring.

SCHOOL OF ARTS—MADRAS.

I.

For more than a quarter of a century this most useful institution existed on the same site, but in a set of low, damp, dilapidated looking constructions, originally forming a coach factory, and altogether unsuitable as a School of Arts. Dr. Hunter seeing how fast the old indigenous art talent of this country, visible in all around us, was being extinguished by the new order of things, recognized the necessity of some supreme effort to stop the unnatural decay, and established this school to take the place of the old Rajahs and Nabobs who were the great patrons of the arts in past days.

Around their palaces were the shops or schools in which all the elaborations of Indian Art, in all its vast native luxuriance of productive power were taught by father to son or master to apprentice; each master vied with the other to produce something new or uncommon and thus gain the approval of the Rajah and others in his palace. And there was an unlimited mine to work from. Between the Himalayas and Comorin was a microcosm, in which was concentrated the productive power of the whole world, from the snow and moss of the frigid Zone to the burning sands and majestic palms of the tropics. If there are unconscious sympathies between mind and nature, man had here only to look and to learn. But the great exciting cause that gave life and motive to every effort was at the Rajahs' palaces, and when the English came and with ruthless hands swept these away, it seemed as if Indian Art would die with them, unless some thing were raised to take their place, and hence the establishment of this School of Arts, so early in the new history of this old country.

Dr. Hunter, the founder of this school and its first Superintendent, accomplished a noble work. His students are scattered through the length and breadth of the Madras Presidency. His lectures on Mineralogy and Botany, by disclosing to the students of Art the hidden workings of nature, their greatest teacher and model, introduced a new train of ideas into the Indian mind. What to them before was dark was now illumined. What appeared low was raised and refined, and mystery and awe fled away before this enlightening light. The Indian mind before looked only at that which was outward, and made this symbolic of what they did not see and could not understand. For instance, to express the elements of superior strength and power, the consort of Siva is given six hands, and mounted on a lion, is destroying a bull-headed demon, so also their other vague attempts at expression, by increasing the numbers of heads, hands, wings, and legs of

their figures, and the grotesque combination of men and animals, to illustrate strength, swiftness, wisdom, beauty, &c. Dr. Hunter's lectures explained that the tiniest ray of sun light travelling its long, swift journey and forcing the sturdy oak of a thousand years to unfold its blossom and yield its fruit, showed more of power and swiftness than any number of arms and wings. Thus by unfolding the simple truths of botany and mineralogy, he hoped best to purge Indian Art of its old grotesque abominations, and make it in time as pure and chaste as nature itself.

Dr. Hunter was, however, unhappily in advance of his age. Few then understood the necessity of an art and technical education. Many looked upon the Doctor as an enthusiast, and most of his work as learned luxury. He did not receive the encouragement he deserved, and had altogether a very uphill time of it. Housed in damp and dilapidated buildings, there was nothing on the surface to attract students to its crumbling walls. It required the experience of the good done in other countries by Science and Art Schools, such as at Kensington, &c., to awaken the public mind to its responsibilities with reference to the Madras School of Arts. But this did not take place till some years after the good Doctor had left India. When the demand came, others however were found worthy to take his place. In 1880, Mr. R. F. Chisholm, the Consulting Architect to Government, and the then most popular man in Madras, was appointed Superintendent of the School, who brought all his characteristic energy to bear on this new work. General Sankey was just then also appointed Chief Engineer. These two combined worked a revolution in the School. The Government were induced to purchase the old premises, which were well located, and had been for the last quarter century rented from a private individual. They next pulled down portions of the old building and erected the "Higher" and "Lower" drawing class-rooms. Two years after the "Museum," a hall 119' × 41' 3" was built. Both works on designs by Mr. Chisholm. And lastly the "Middle Drawing Class" and "Glass Making Shed," &c., were erected by the late lamented Colonel Morant, R.E.

The whole of this work cost only Rs. 70,000, and scattered over about 5 years the burden did not fall heavy on the Madras Government.

Sir Grant Duff in his now famous review minute mentions this as one of the improvements carried out during his administration, and all will admit that it is improvement in the right direction. Any one similar useful work ought to be enough to give character to any administration, and to enlist the active sympathies of a naturally grateful people.

In our next we will give details and illustrations of some of the more striking portions of the building.

J. H. S.

THE CONSTRUCTION OF THE HONEY-CELL;

OR,

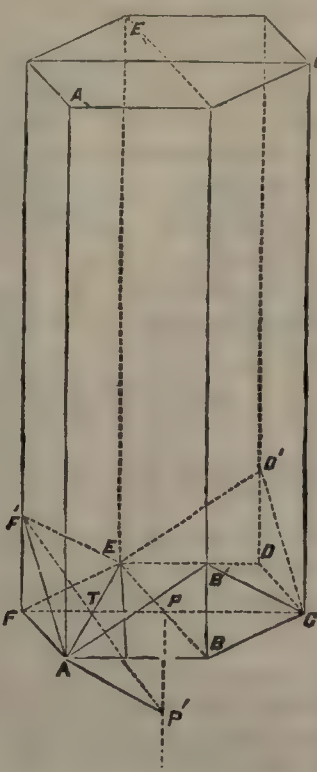
THE BEE AND HIS D. P. W.

BY A. EWBANK.

V.

IN *fig.* 7 we have a rough mathematical diagram showing the shape of one cell. There is no attempt to represent the cell in its true proportions. Even if we take arbitrary lengths for the original axial lengths and for the side of the cross-section, we could by Descriptive Geometry indicate the figure truly in plan and elevation and then—still working by Descriptive Geometry—we could throw the whole cell into true perspective on one arbitrarily chosen plane. But this has not been done. The figure is only a mathemetical diagram to assist in the comprehension of the text. The length x of PP' should equal FF' or DD'. But as it is convenient to remember that P'F' should bisect AE, the line F'T has

Fig. 7.

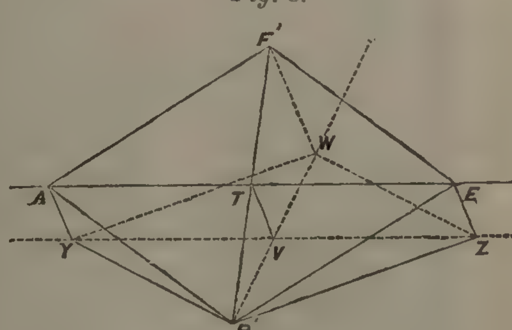


been drawn and produced and the length PP' is left to be so determined. Thus the base of the cell is roughly denoted by the areas P'AF'E, P'ED'C, P'C B'A. We may now make some calculations. Let $P'A = AF' = y$ and $AP'E = 2\,\theta$; $AE = 2\,AT = 2\,y \text{ Sin } \theta$. Also $AE = 2AF \text{ Sin } 60° = AF\sqrt{3}$; $\therefore$ side of original hexagon $= AF = \dfrac{2y \text{ Sin } \theta}{\sqrt{3}}$;

$\therefore\ x_1^2 = FF'^2 = y^2 - AF^2 = y^2 - \dfrac{4y^2 \text{ Sin }^2\theta}{3}$ or $FF' = \dfrac{y}{\sqrt{3}}\sqrt{3 - 4\text{Sin}^2\theta}$. We will now find the volume of the new cell.

If the lines A_1A, E_1E, .. of the cell be produced downwards to meet a horizontal plane through P' they will on it trace out a hexagon of side equal to FA. The whole volume over this hexagon and up to the plane $A_1E_1C_1$ exceeds the true cell volume by three wedge-shaped volumes equal to each other. One of these is shown in *fig.* 8. YP'Z is the horizontal plane. F'W is a vertical on it.

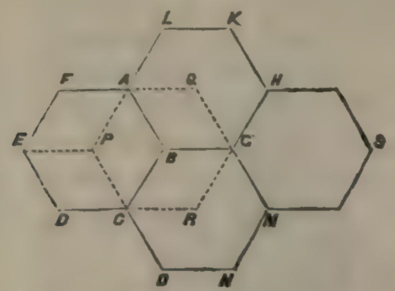
Fig. 8.



AY, E Z are also perpendiculars. The volume we are considering—say volume U—is included between the vertical planes P'AY, AYWF', WF'EZ, EZP', the top face P'AF'E and the base P'YWZ. If we were also to project the areas P'ED'C and P'CB'A of *fig.* 7 in the same horizontal plane through P' we should get the complete hexagon; and P'YWZ is one rhombus of it like PEFA in *fig* 5.

The volume U is found by multiplying the base by the height over it of the centre of gravity of the top face. This we may perhaps assume. Thus volume $U = P'YWZ \times TV$; $3U = \text{hexagon} \times TV$; $\therefore$ cell volume $= \text{hexagon} \times (A_1A + AY) - \text{hexagon} \times TV = \text{hexagon} \times A_1A =$ original cell

Fig. 5.



volume when its base was plane. Let the original height be $h = A_1 A$.

Then volume of cell$=6\,h\,\frac{\sqrt{3}}{4}AF^2 = 2\,h\,y^2\sqrt{3}\,\text{Sin}^2\theta$.

Now y and θ must so vary that $AF = \frac{2y\,\text{Sin}\,\theta}{\sqrt{3}}$ is constant. Let $AF = \frac{2c}{\sqrt{3}}$, then $y\,\text{Sin}\,\theta = c$ (1) = a constant. The surface of the cell$=3\,P'AF'E + 6.\,FA \times AA_1 - 6\,\Delta\,AFF' = 3y^2\,\text{Sin}\,2\theta + 6\,h.\,\frac{2}{\sqrt{3}}\,c - 3.\,\frac{2c}{\sqrt{3}} \times \frac{y}{\sqrt{3}} \times \sqrt{3-4\,\text{Sin}^2\theta} = 6\,c\,y\,\text{Cos}\,\theta + 4\,h\,c\sqrt{3} - 2\,cy\sqrt{3-4\,\text{Sin}^2\theta}$. This surface we want to be a minimum subject to the condition $y\,\text{Sin}\,\theta = c$. We need therefore only consider the minimum value of $3y\,\text{Cos}\,\theta - y\sqrt{3-4\,\text{Sin}^2\theta}$ (2). This is the point at which it is convenient to use the Differential Calculus. Accordingly we have $\delta y\,\text{Sin}\,\theta + y\,\text{Cos}\,\theta\,\delta\theta = o$ by (1)

$$\left\{3\,\text{Cos}\,\theta - \sqrt{3-4\,\text{Sin}^2\theta}\right\}\delta y + y\left\{-3\,\text{Sin}\,\theta + \frac{4\,\text{Sin}\,\theta\,\text{Cos}\,\theta}{\sqrt{3-4\,\text{Sin}^2\theta}}\right\}\delta\theta = o \text{ by (2);}$$

$$\therefore \left\{3\,\text{Cos}\theta - \sqrt{3-4\,\text{Sin}^2\theta}\right\} y\,\text{Cos}\,\theta = \left\{\frac{4\,\text{Sin}\,\theta\,\text{Cos}\,\theta}{\sqrt{3-4\,\text{Sin}^2\theta}} - 3\,\text{Sin}\,\theta\right\} y\,\text{Sin}\,\theta,$$

or $3(\text{Cos}^2\theta + \text{Sin}^2\theta)\sqrt{3-4\,\text{Sin}^2\theta} = (3-4\,\text{Sin}^2\theta) \times \text{Cos}\,\theta + 4\,\text{Sin}^2\theta\,\text{Cos}\,\theta$,

or $3\sqrt{3-4\text{Sin}^2\theta} = 3\,\text{Cos}\,\theta$;

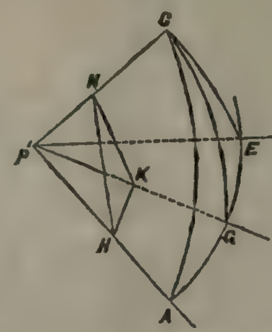
$\therefore\ 3\,\text{Cos}^2\theta = 1.$ (3)

This is that purely geometrical question which has already been solved by many mathematicians. Although I have seen none of their demonstrations yet I presume they cannot differ much from each other or from the one now given.

We need not again apply to the Differential Calculus and the result (3) we may if we like suppose given by actually measuring the angles in a bee cell. Also whether the angle in a bee cell found by measurement is exactly that which gives a minimum surface is not as I think a matter of prime importance for the bees are sensible professional insects who keep questions of geometry and of wax economy in their proper subordinate places.

If $\text{Cos}^2\theta = \frac{1}{3}$, we have $3-4\,\text{Sin}^2\theta = \frac{1}{3}$; $\therefore\ FF' = \frac{y}{3}$, or $PP' = \frac{1}{3} P'A$. Thus the pyramidal edges which meet at the centre of the new base make with the axis of the cell the angle $\text{Cos}^{-1}\frac{1}{3}$. Let us now find the angle $2\,\phi$ between two faces of the pyramidal base. This pyramid is shown in *fig* 9. The letters P', A, E, C, are the same as *fig* 7. Take a sphere of centre P' and radius $P'A = y$. The face P'A E cuts this sphere in the circle A G E. Similarly for the faces P' C A, P' C E we have circular arcs C A, C E. G bisects the arc AE and

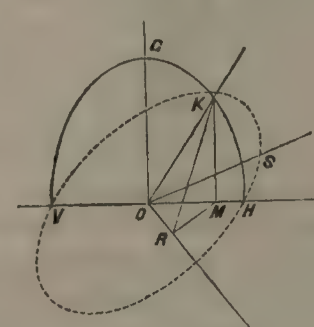
Fig. 9.



C G is the arc in the plane C P' G. This plane bisects the angle 2ϕ between the faces EC and AC. Let H be any point in P'A. Draw H K perpendicular to P'G and K N perpendicular to P'C. Then HN will be perpendicular to P'C. Thus $\text{Sin}\,\phi = \text{Sin}\ HNK = \frac{HK}{HN} = \frac{\frac{HK}{HP'}}{\frac{HN}{HP'}} = \frac{\text{Sin}\ AP'G}{\text{Sin}\ AP'C} = \frac{\text{Sin}\,\theta}{\text{Sin}\,2\theta} = \frac{1}{2\,\text{Cos}\,\theta} = \frac{\sqrt{3}}{2}$; $\therefore \phi = 60°$, and $2\phi = 120°$.

Lastly we may inquire what is the angle between a pyramidal face such as P'A F'E and one of the vertical walls which it meets—say $F'FEE_1$. In *fig.* 10 we have a

Fig. 10.



sphere whose centre is O. The great circle V G H represents in direction the plane F P C C, of *fig.* 7 The direction of the plane P'AF'E is represented by its normal which in *fig.* 10 is the line OK which normal must lie in the plane $FPCC_1$ of *fig.* 7 *i.e.* in VGH of *fig.* 10. The plane FEE_1 of fig 7 is the same as G O S of *fig.* 10. The normal to G O S is the line OR which lies in the horizontal plane VSH. The angle between OK and OR is equal to one of the two supplementary angles which are made by the planes P'AF'E and $F'FEE_1$.

In *fig.* 10 the angle R O M$=30°$ and K O M is the complement of F T F' in *fig.* 7. $\therefore$ K O M$=$F F' T.

Now in *fig.* 7 $FF' = \frac{y}{3}$, and $FT = \frac{1}{2}\,FA = \frac{1}{2}.\,\frac{2y\ \text{Sin}\,\theta}{\sqrt{3}} = \frac{y\sqrt{2}}{3}$; $\therefore$ Tan K O M$= \frac{FT}{FF'} = \sqrt{2}$; $\therefore$ Cos K O M$= \frac{1}{\sqrt{3}}$.

In *fig.* 10, K M is perpendicular to O H and M R to O R; $\therefore$ K R O$=90°$; $\therefore$ Cos K O R$= \frac{OR}{OK} = \frac{OR}{OM}\cdot\frac{OM}{OK} = \text{Cos}\ 30°$. Cos K O M$= \frac{\sqrt{3}}{2}\cdot\frac{1}{\sqrt{3}} = \frac{1}{2}$; $\therefore$ K O R $= 60°$. Therefore that angle between the vertical wall F' F E E' and the sloping face P' A F' E which we may call the inside angle—as seen by looking into the cell—is 120°. Thus in the modified cell all the planes meet each other at 120°.

(To be continued.)

MANUFACTURE OF CONDENSED MILK.

(Translated from *Le Monde de la Science et de l'Industrie*, For INDIAN ENGINEERING.)

THE condensation of milk involves a process which has the sole object of drawing off the large quantity of the water contained in it, by a series of operations which in no way destroy its natural properties,—which, for instance, would be the effect of boiling under ordinary conditions. By the addition of sugar and by inclosing the liquid in perfectly air-tight and hermetically sealed tins, manufacturers have succeeded in America, for the last thirty years, in preserving its essential qualities and in rendering it capable of transportation to any distance without injury and in a considerably diminished compass. By simply adding some water at the moment of consumption, it is at once restored to its original quantity.

During the War of Secession in the United States, condensed milk was of the greatest benefit to the troops in the field. It has, since that time, become an important article of food for sailors and soldiers, and at Tonkin it was the only nourishment that the sick men suffering from dysentery and chronic diarrhœa were able to digest. The late regretted Dr. Züber, in his enthusiasm over the excellent results obtained from it, said that a statue should have been erected to the inventor of condensed milk.

This manufacture is increasing every year; it has crossed the ocean, and a little village of Cham on the Lorze, which at a short distance from thence flows into Lake Zug, has now become the seat of an industry which daily condenses the milk of 80,000 cows, about 60,000 litres,* and which sends out yearly from 15 to 17,000,000 tins of milk.

These works, which are the most important of seven manufactories belonging to a wealthy and influential company, commenced operations about twenty years ago. At that time the manufactory condensed the milk of 263 cows and sent out for consumption 137,000 tins of 4,339 grammes † each. The milk is supplied by the farmers at the rate of 12 centimes the litre, and the company undertakes to send for it to their farms.

MM. Grandeau and Kramer of Zurich describe the process of condensation as follows :—

On its arrival at the manufactory, the milk is immediately poured into a reservoir provided with a silken sieve, which filters it and retains all accidental impurities. This reservoir forms at the same time the scales of the weighing bridge in which everything is weighed on arrival. The milk flows through a plug raised after each weighing, into large boilers of copper, heated to 35°C. by steam; one-eight K. of its weight of sugar-candy is then added to it. As soon as the sugar is dissolved, the liquid runs automatically into empty boilers, in which it undergoes condensation at a temperature of 52°C. under a depression of about 10 centimetres (4 inches) of mercury. Under these conditions the milk boils without its constitutive elements (fat, caseine, etc.), undergoing the slightest change. In the space of three hours each boiler reduces to one-third of its original quantity, by elimination of the water, 70 or 80 hundred-weight of sugared milk. From the condensation boilers, the liquid, now of the consistency of a fluid syrup, flows into large cylinders which keep plunging into water constantly renewed, where it rapidly cools, owing to the automatic agitation of the vessels, and of the liquid itself. As soon as it is cold the milk rises by machinery through a passage into the workshop, where it is distributed into metallic boxes, which are immediately sealed and are ready for consumption. Each of the vessels used in carrying the milk to the works is at first washed with water, vigorously scrubbed inside, and finally cleaned with steam before being returned to the supplier.

The treatment of 67,000 litres a day, the preparation and filling of from 40 to 50,000 tins of condensed milk, and the daily sending away of these enormous supplies, are only possible with the aid of machinery. From the cutting out of the sheets of tin used for making the boxes to the nailing down of the dealwood packing cases which carry them away, everything is done by machinery, and a single clever workman can solder up 4,000 tins in his day's work of 10 hours, at the rate of 400 the hour.

A. A.

* A litre—slightly over 1 seer—about $2\frac{1}{2}$ pints.
† About 1lb. 10oz.

NOTES FROM HOME.

(*From our own Correspondent.*)

AT a meeting of the Society of Engineers on Monday last a paper was read on Bridge Floors; their design, weight and cost by E. Olander, in which the author first described floorways based on cross-girder construction and proceeded to consider the modern floors of corrugated or trough construction. Of this ten different sections were compared by bringing them all to one depth, and as nearly as possible to one uniform weight per square foot and then analysing their strengths. A description was also given of tests applied to some of these floorings. The paper was admirably illustrated and is a comprehensive treatise on the subject forming a reference that must add greatly to the value of the Society's Transactions.

There is interesting matter to Indian readers in the last issue of the Journal of the Society of Arts, which contains in the proceedings of the Indian section a paper by Mr. Hallett on "New Markets and Extension of Railways in India," and the Foreign and Colonial section a paper on the "Indian and Colonial Exhibition" by Sir Cunliffe Owen. In the latter reference is made to the great share that India took towards its success in sending magnificent collections, which were contributed by their Highnesses the Princes of India, to whose generosity and hearty co-operation the Indian section owed some of its most attractive features. In reference to the subject-matter of the former paper it may not be out of place to note that the commercial papers speak of the recent issue of three millions capital for the Bengal-Nagpur Railway by Messrs. Rothschild, as a success and deservedly so; that there is room for the profitable employment of a hundred millions in Railways in India and Burmah; that Manchester is far more deeply interested in the creation of new railways in India than such wild schemes as the Manchester Ship Canal; and that the modest demand of Messrs. Rothschild will probably develop into further demands of ten times the present amount.

A two-page illustration is given in *Engineer* showing the Locomotive History of the South-Western Railway between 1851 and the present time, commencing with Mr. Gooch's engine built in 1851, and finishing with Mr. Adams' expresses of 1880 and 1883. The traffic on this line is heavy and the engines of Mr. Adams have complied satisfactorily with all the demands made upon them. They are specially remarkable for their great strength of parts, resulting in a minimum of repairs. This Railway has adopted, under the advice of Mr. Adams, Locomotive Superintendent, an improved form of Mansell's wood wheels, which is illustrated, and a specification of which is found in the *Railway Engineer* of this month (March).

A most exhaustive and valuable work entitled "A Comprehensive Reference Book of Practical Mining" has just been issued by W. Wardle, a well-known Mining Engineer and Colliery Manager. The work is elaborately illustrated throughout and contains a vast amount of practical information respecting coal mines, and it commends itself to those of your readers who have the management of collieries, and those who are being educated for the same position as a most valuable work of reference on all matters that are likely to arise in connection with the safe, economical and scientific working of coal mines.

General Hutchinson's report on the collision which occurred at Carlisle on the 21st December last has just been issued. It says :—The collision was undoubtedly caused by the action of the vacuum brake having been stopped. The advantage of the automatic brake arrangement advocated by the Board of Trade over that now in use on the London and North-Western Railway is also made manifest, for had the automatic arrangement applied to the whole of the mail train instead of only three brake vans, and had it been applicable to either one of the three guards, the train might easily have been stopped at the proper place when the driver found that the vacuum brake would not work and gave the brake whistles.

Apropos of brakes, the *Railway Engineer* of this month (March) gives an account of trials with a brake recently introduced by Messrs. Ransome and Rapier, the well-known firm of Engineers at Ipswich, made on the Hadleigh Branch on the Great Eastern line. This brake is actuated by the action of gravity that its normal state is "brake on," compressed air vacuum steam or other fluids being used to take off or control the brakes.

The *Engineer* gives some further illustrations of the

works of the Forth Bridge. In this case a perspective view is given of one of the rivetting cages in which the vertical girder is shown which carries one part of the rivetting apparatus, while the other part of the rivetting machine is attached to the pivotted girder in the centre.

Newcastle Exhibition is now nearly completed. Progress is being rapidly made with the old Tyne Bridge, and the houses and shops that are to be placed upon it will probably be commenced at once. A coal mine is to be a feature at this Exhibition.

REPORT ON THE AURIFEROUS TRACTS, MYSORE.

(Continued from page 82.)

Holgere Field.

The rock of the country is sedimentary, metamorphic or transition rock with a dip to the East of 62°. The strike of the whole country is 15° East of North. I commenced work about 2 miles to the South of Holgere and prospected the country for about 2 miles East and West, where I found gold. There is also an old working done by the ancients at this point, and I have reason to believe old workings continue to the South. The auriferous zone or belt is here about ½ mile wide and flanked on the East and West by mica schist, the whole breadth being about 2 miles. The mica schist carries but very little gold, the main or richer portion of the country being micaceous trap, with the auriferous quartz lodes running parallel with the strike of the country, *viz*, 15° East of North. About one mile North of the point first investigated there is a very large old working with several small ones. This large old working must have been carried to a very great depth by the ancients, and no doubt a very considerable quantity of gold must have been obtained by them. Some of the quartz which I tested, not from the old working, but from cross-cut trenches recently excavated by Mr. Blamy and party, I found what the miner would call a fair show of gold. Again, a little to the North-West in some watercourses, which I examined, I found a very fair show of gold—in fact, what might be called a very good prospect. On going North I found gold in a few places and one shallow old working. About a mile and a half from the large old working to the North, the mica schist slate is intruded upon by talcose schist slate, and a cross course running 45° East of North, here cutting off the gold until the Kabani River is crossed to the North. This cross course passes through the bed of the Kabani about half a mile to the North of the bridge at Nanjangud at a small Hindu temple and continues in the same bearing for about 2 miles. I examined the country most carefully from this cross course to the South bank of the river without finding a trace of gold. I also examined the country commencing three miles West of Debur and continuing my investigation as far as Nanjangud without finding a colour of gold. I investigated the country 10 miles South of Mysore to the West of the public road along the banks of a small stream that runs a little to the North of the village of the Kadkole where I found gold in the first test, and continued the examination for about 3 miles to the West. In almost every test I found gold. The tests were not made in the bed of the river nor in the deposits of the river, but from the high ground, and principally from where the country rock was laid bare at various distances from the stream, being most careful that there was no chance of the gold being carried by storm-floods and deposited where found. The formation here differs considerably from that on the South bank of the Kabani where gold was found. The rock here is schist highly laminated with thick veins of quartz running parallel with the slate, also small trap dykes running in the direction of the strike of the country, the whole having an overlay of lime kunkur which in several places fills the joints of the slate rock. The trap here carries a very large quantity of iron and is in a high state of decomposition. The quartz is very granular and in places felspathic and is also in a state of decomposition. I found no well defined reefs of quartz here, as I have done to the South of the Kabani. The strike of the country here is 50° East of North or 10° more to the North than that on the South side of the river.

I continued my investigation to the East of the public road from Mysore to Nanjangud at Kadkole along the North bank of Yenne hole, where I found gold about one mile from the road, but in very small quantity. I continued my investigation still further East to the low range of hills to the East of Ayarhalli, taking to the North on to Ranganadapuram and crossed the Cauvery River on to Bannur. Mr. Marsh joined us on the 5th May 1886 at Ranganadapuram. We proceeded from Bannur along the North bank of the Cauvery investigating the hills lying to the North as far as the Railway near the one tree hill. Gold was only found by us to the East of Kambarayanbetta, and that only a trace. We made several tests through this range of hills, but were not successful in finding the precious metal. The above portion of the country travelled over by us is micaceous hornblende gneiss, with, as far as I can judge, an underlay of granite. Large quantities of iron ore are to be found in this range. The dip and strike of the country is the same as that described above. Many outcrops of granite running into ranges parallel with the strike of the country are to be found North and South from Chamandi hill, which we visited on our return journey through Nanjangud to Chamarajnagar We commenced our investigation to the East of Kavalandi upon a range of hills about one mile from the village, and found in all our tests no other mineral but iron. This range is of the same formation as that North and South of the Cauvery. Some very fine hornblende is to be found here and there in these rocks, also felspar of various shades, both being of no intrinsic value. We examined the hills to the East of Badanaguppe and found them to be granite. Hornblende and felspar also occur here. Small dykes of felspar and hornblende schist run parallel with the strike of the country. Iron sand in abundance is also found here. We then proceeded to Chamarajnagar, where we met the Amildar. He gave us information about some old iron workings at Kallur and Dodgaudanpalya, which lies to the South-East about 15 miles from Chamarajnagar on the Hasanur road. These old workings were reported some few years ago as being exceedingly rich in gold, which induced a friend of mine and my self to visit the place, which we found to contain no gold, but large quantities of iron ore, which had been excavated during the time of Hyder Ali. The old pits are very much filled in, as large quantities of *débris* are carried down annually by the storm water from the Annamale Range. The formation here is hornblende and gneiss with very heavy outcrops of granite. A second investigation of this place would be a waste of time, and I deemed it expedient to push my way on as rapidly as possible through Gundlupet and a portion of Heggaddevankote Taluk to Hunsur. Magnetic iron ore occurs 6 miles to the South-East of Gundlupet. This we did not visit, as this quality of ore can be found almost over the whole of Mysore. The iron workings at Lankipur had been visited by me before, and as the object of this Party is only to report upon the more precious metals, I did not visit Lankipur. We proceeded North-West from Hampapur about 6 miles to the village of Sonnahalli in the Hunsur Taluk. Here old gold workings were known to exist by the natives. We received our first information from the Amildar of Nanjangud about the existence of old workings near Karimuddenahalli. Mr. Marsh also knew some of these old workings, as he had visited them professionally on the part of Messrs. Wilson and Co.

The country rock here is chloride schist, one of the most favourable gold-bearing formations in Southern India. This formation extends to the South, but for what distance I cannot tell, and runs North as far as Dharmapura, where the country is thrown from the strike of 18° to the West of North to 45° East of North or a throw of 63° to the East. This occurs through a granite band running from the Hunsur direction on to Chamandi, the granite outcrop showing itself strongly to the North of Gagenahalli.

STRAY JOTTINGS.

(From an Occasional Correspondent.)

The enthusiasm in connection with the Queen's Jubilee is still spreading, the various cities and towns throughout the kingdom vieing with each other to express their loyalty in various ways, and notably in meetings of influential citizens to take action in assisting the establishment of the proposed Imperial Institute in London. Whatever may be carried out in the way of facilitating a more complete union and federation of the Mother Country with other parts of the Empire is to be heartily welcomed.

The changes which were lately introduced into the Atlantic Postal Service have brought out the steaming qualities of the various "liners" which ply to America. The last and most startling item as regards speed being that the *Etruria* one of the famous Cunard line made the passage from Liverpool to New York in 6 days 19 hours.

The Spanish Government appear to be bestirring themselves in the way of war ships. Recently the extraordinary rapid run across the Bay of Biscay by a new Spanish torpedo boat built by Messrs. J. G. Thomson, Glasgow, was noticed, and now there has been launched from the yard of the same firm at Clydebank an armoured cruiser for the same Government. This vessel to be named the *Reina Regenté* is 330 feet long, displacement 5,600 tons, built of steel ; she has as many as 156 water tight compartments. The engines are horizontal acting with triple expansion driving twin screws. The armament is heavy, consisting of four 21 ton guns with smaller pieces, torpedo apparatus, &c. The guaranteed speed is 20½ knots.

The first 110 gun for H. M. S. *Benbow* has just been successfully tested at Woolwich Arsenal. The projectile is 1,800lbs. weight ; bore of gun 16¼ inches. Charges of 600 and 850lbs of powder were used giving a muzzle velocity of from 1699 to 2078ft. The length of the gun is about 43 feet.

Submarine torpedo boats are being devised apparently, from the experiments, with a considerable measure of success. So that shortly a new and dread enemy will be found in these fish-like structures.

The Institution of Mechanical Engineers have been busy discussing the economy of steam, and the advantages of triple and quadruple system of expansion have been thoroughly investigated. Pressures rising up to 150 and 200lbs are discussed as likely to be common—the use of steel in boiler shells and corrugated flues enabling the Engineer to gain these desired extremes of pressure. The rates of the capacity of the three cylinders was discussed. Some speakers suggesting 1,2½ and 7½, others that the diameters should be as 2,5, and 8. Forced draught in boilers was also discussed, some thinking that the next important improvement would be in this direction.

The question of the heating of American passenger cars has engaged some attention of late on account of the lamentable catastrophes which frequently happen, due to cars taking fire after an accident. It seems singular that both at Home and in America wood should still be so much used in the structure of railway carriages ; one would think that thin steel plates, corrugated if necessary, might be largely employed for such purposes.

A new pair of compound tandem engines have just been set to work at Messrs. Coats' new thread mills in Paisley. The high and low pressure cylinders are 30 inches and 50 inches respectively. The fly wheel weighs 120 tons, is 35 feet diameter, and is grooved for 40.—⅞ inch ropes, and will make about 50 revolutions per minute. The indicated horse power is about 2000.

Centrifugal pumps are most valuable appliances for lifting water and are largely used in dock works and drainage operations. They first were brought forward in 1851. This form of pump readily adapts itself to varying lifts.The suction of the rapidly rotating fan causes or tends to cause a partial vacuum in the casing to which the water rises and is then ejected. There appears to be a good deal of variation in the action of these pumps as no satisfactory rules showing the relation of power expended to work done seem as yet to be formulated.

Earthquake shocks have been felt along the Mediterranean Seaboard from Rome to Marseilles. The direction of the wave appears to have been from east to west. Great damage has been done and several hundreds of lives lost besides a large number of persons wounded. It is supposed that earthquake shocks originate from a central point, the area of disturbance varying with the extent to which the earth waves are propagated

The floating out of last girder of the Tay Bridge has now been successfully accomplished. These large girders, varying from 145 feet to 300 feet, have been mainly placed in position by hydraulic power. The process was to float them out from the shore where they were built on pontoons specially designed for the purpose, and after being brought into position they were raised to their proper level by hydraulic pressure.

This application of the use of hydraulic power is not new as Robert Stephenson used it to raise the great tubes of the Britannia Bridge, which spans the Menai Straits in Wales. The spans varied from 300 to 460 feet—brick building being executed below them as they advanced upwards. Mr. Wm. Arrol, who is erecting both the Tay and Forth Bridges, uses hydraulic power very freely to assist and reduce manual labour, the excavation of the stiff material in the foundation of the caisson for the Forth Bridge having been done mainly by a hydraulic spade invented by Mr. Arrol. In these applications and many others Mr. Arrol has shown himself a man of great fertility of invention and resource.

The new Tay Viaduct is expected to be opened for railway traffic in May or June this year.

The Forth Bridge works are proceeding satisfactorily. The various tubular struts and ties constituting the lower parts of the great cantilevers are now appearing and rise to a considerable height. It will be a couple of years at least, however, before the work is finished.

In reference to this great undertaking, Mr. Baker, C. E., one of the Engineers for the Bridge, at a recent lecture said there were 3500 men employed, 30 tugs, barges,&c, 60 steam cranes, 50 hydraulic cranes, 100 hydraulic jacks, 100 steam drilling machines, 48 steam engines, 350 hydraulic rivetters, besides other machine tools and appliances at work on it.

The old system of rope haulage has been much developed of late years, notably in America, where in several of the large cities the cable car system has been for some years in operation. A sub-way worked on this principle is at present proposed to be constructed in Glasgow. It appears that where the traffic is heavy such cable system is economical, the wear on the rope however is great, renewals requiring to be made about annually.

COLOMBO HARBOUR WORKS, CEYLON.

By John Kyle, M. Inst. C. E.

(Continued from page 155.)

Progress of the work.—The amount of work accomplished each season, up to 1882-83, is shown in the following table :—

Season.	Working Days.	Blocks set.		Length of Wall.
		Sea Wall.	Harbour Wall.	
	Number.	Number.	Number.	Feet.
1876-77	123	617	...	375
1877-78	134½	923	141	556
1878-79	23	107	...	74
	198½	...	491	680*
1879-80	88¾	822	...	458
	139⅓	...	355	434*
1880-81	130½	1,953	...	946
1881-82	129⅔	2,340	...	952½
1882-83	118	1,907	...	787⅜
Totals ...	1,085¼	8,669	987	4,149⅜

In April 1878, an unusually heavy south-west monsoon set in, and swept away a 14-ton block from the second upper course of the scar end ; increasing in strength in July, the sea drove in the scar end of the sea-wall, which was 700 feet in advance of the harbour-wall, to the extent of 15 inches, pivoting on a point 150 feet landwards, and lowered the end 12 inches, diminishing to nothing 450 feet in. Accordingly, to avoid damage, the extension of the sea-wall was stopped till the harbour-wall was brought up to it. During the season 1879-80, the harbour-wall progressed very slowly, owing to large quantities of sand having been washed on to the foundations by the south-west monsoon of 1879, which had to be removed by divers. For instance, in November and December 1879, only four sloping sections of the harbour-wall were set ; whereas twenty-four sections of the sea-wall, having double the width, were set in the same time.

In the eighth season, 1883-84, with one hundred and ninety-five working-days, the pier-head up to quay-level, the lighthouse tower, the landing-pier, and the apron of concrete bags on the berm, were completed, comprising 6,922 cubic yards of concrete-in-mass, and three hundred and fifty-three 3-ton, and nine hundred and twenty-eight 7-ton blocks altogether.

The work was finished in the season 1884-85, comprising the completion of the pier-head and the lighthouse fittings, and also the concrete-in-mass capping from the pier-head to the shore, containing 15,000 cubic yards.

Settlement.—The amount of subsidence which took place during each south-west monsoon was carefully measured. The maximum settlement along the centre line was 2 inches, and the average 1½ inch. In 1877, there was a settlement of 18 inches on the seaside ; and during the monsoon of 1884, a maximum settlement of 4 inches occurred between 490 and 500 feet from the shore.

Dredging, Reclamation, Moorings, &c.

Dredging.—The position of the 85½ acres in the harbour, to be dredged to a depth of 26 feet at low-water, is shown by a dotted line on Fig. 1 ; the amount to be dredged was 887,459 cubic yards, of which 678,459 cubic yards had been completed up to 1884. The sheltered water-area in the harbour is 502 acres at low-water, 329 acres with a depth of 18 feet and upwards, 242½ acres of 26 feet and over, and 90½ acres of 30 feet and more. A single ordinary bucket-dredger, of 75 nominal H.-P., was employed, capable of dredging in 29 feet of water. The dredgings from the harbour were conveyed 4 miles out to sea, and dropped in 15 fathoms of water by a hopper-barge carrying 500 tons, and making three trips a day in full work, or on the average two and a half trips. The barge cost £11,333 delivered at Colombo. An auxiliary barge took its place whilst absent on its trips, and carried away three cargoes of 75 cubic yards each.

Reclamation.—A rubble mound, 9 feet wide at the top, and averaging 37 feet in width at the base, and14 feet in height, extends 2,600 feet along the southern shore-line of the harbour, reclaiming an area of 20 acres, which was filled up with harbour-dredgings (Plate 2, Fig. 1) A backing of cabook, 6 feet in width, was deposited behind the mound ; and the quay-level was completed with a 12-inch layer of cabook, 5 feet above low-water. The dredged sand was brought to the landing-stage in two trains of five barges, containing 20 tons each, towed by a steam-tug. The total quantities of material used were 51,475 tons of rubble and 290,641 cubic yards of cabook and dredgings, at a cost of £45,344.

Moorings.—Four tiers of six buoys each were fixed parallel to the breakwater Fig. 1. The first tier is 300 feet from the pier-wall ; and the buoys are 600 feet apart each way.† Twenty-five steamers of the largest class can moor in depth of from 26 to 40 feet of

* These lengths of harbour-wall do not form part of the total length.

† The Author adopted the following method for sinking the collar of the screws. A cylinder, 5 feet in diameter and 6 feet high, was lowered from a barge fitted with suitable gearing, and it was sunk by divers removing the sand from inside. The screw and collar were then lowered into the cylinder, and screwed into the bottom to the full depth ; after which the cylinder was removed.

water: whilst there is space at low-water for a great number of vessels drawing from 6 to 26 feet. A vessel entering the harbour at night steers into the line of the fairway lights, where a passage of 600 feet is kept open for convenience in berthing. The cost of the moorings was £7,411.

Revenue of the Harbour.—The collection of revenue from the new harbour began with 1883; during the two years 1883 and 1884 it amounted to Rs. 4,11,318 and Rs. 4,08,566, equivalent to about £34,276 and £34,047 respectively.

Management of Works.—The whole of the drawings from which the works have been executed, including the contract drawings for the special plant and machinery, were prepared by the Engineer-in-Chief, Sir John Coode; and the works were carried out by the Author, who had the charge and management of their execution, as Resident Engineer, from the commencement, Mr. Charles Good, Assoc. M. Inst. C. E., being the Assistant Engineer. The special plant and machinery were constructed, and their working was thoroughly tested before leaving England, under the superintendence of Mr. William Matthews, M. Inst. C. E.

COST OF WORKS.

Summary of Gross Total Expenditure in currency and sterling up to 31st December 1884, with estimate to complete the whole work.

Description of Works.	Expenditure to 31st Dec. 1884.		Estimated Expenditure to complete the Works.	Gross Total Cost of Works.		Expenditure to 31st Dec. 1884.			Estimated Expenditure.			Gross Total Cost of Works.		
	Rs.	a.	Rs.	Rs.	a.	£.	s.	d.	£.	s.	d.	£.	s.	d.
Root work	733,718	76	...	732,718	76	61,059	17	11	...			61,059	17	11
Breakwater mound ...	1,278,644	92	82,350	1,360,994	92	106,553	14	10	6,862	10	0	113,416	4	10
Breakwater pier ...	3,675,716	13	135,283	3,810,999	13	306,309	13	7	11,273	11	8	317,583	5	3
Harbour-dredging ...	570,995	41	67,300	638,295	41	47,582	19	1	5,608	6	8	53,191	5	9
Foreshore-reclamation ...	482,580	32	4,280	486,860	32	40,215	0	6	356	13	4	40,571	13	10
Harbour moorings ...	88,943	77	3,900	92,843	77	7,411	19	7	325	0	0	7,736	19	7
,, leading lights ...	933	18	...	933	18	77	15	4	...			77	15	4
Administration ...	549,860	03	38,100	587,960	03	45,821	13	5	3,175	0	0	48,996	13	5
General workshops ...	545,054	84	30,000	575,054	84	45,421	4	9	2,500	0	0	47,921	4	9
Extraordinary expenditure for work done not connected with construction account, loan charges, &c., &c.	132,681	02	...	132,681	02	11,056	15	0	..			11,056	15	0
Spare gear, tools, and stores not used up	43,142	62	...	43,142	62	3,595	4	4	...			3,595	4	4
Totals ...	8,101,271	00	361,213	8,462,484	00	675,105	18	4	30,101	1	8	705,207	0	0

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, April 9, 1887.

Major F. Firebrace, R.E., Superintending Engineer, 1st class temporary rank, and officiating Consulting Engineer for Railways, Bombay, is confirmed in that appointment, with effect from the 19th February 1887.

Colonel A. J. Filgate, R.E., Accountant-General, Public Works Department, and Deputy Secretary to the Government of India in the Public Works Department, is granted special leave for six months, with effect from the 24th May 1887, or such subsequent date as he may avail himself of it.

Lieutenant William John Bythell, R.E., is appointed to the Public Works Department as an Assistant Engineer, 2nd grade, and posted to State Railways, his services being placed at the disposal of the Director-General of Railways.

Mr. H. O. Walling, Assistant Engineer, temporarily attached to the Office of the Superintending Engineer, Frontier Road Circle, is re-transferred to the 4th Division, Frontier Road, with effect from 1st April 1887.

Director-General of Railways.

Mr. W. Monies, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India, a further extension of leave on medical certificate for six months, in continuation of that notified in Director General of Railways' Notification, dated 6th October 1886.

The undermentioned officers are transferred in the interests of the public service, from the Railways noted opposite their names to the Khwaja-Amran Railway Survey:—

Mr. R. J. Woods, Executive Engineer, 4th grade, temporary rank.
Mr. R. D Percival, Assistant Engineer, 1st grade.
Mr. W. J. Weightman, Assistant Engineer, 1st grade.
Honorable E. H. S. Napier, Assistant Engineer, 2nd grade.
} Sind-Pishin State Railway.

Babu Labdha Ram Sahni, Assistant Engineer, 2nd grade. } Bolan Railway.

N.-W. P. and Oudh, April 9, 1887.

Buildings and Roads Branch.

Mr. D. W. Aikman, Assistant Engineer, 2nd grade, Allahabad Provincial Division, is granted three months' leave, to study the Native Languages, with effect from the 15th April 1887, or subsequent date.

With reference to Government of India, Notification, dated 15th March 1887, appointing him Special Superintending Engineer, Upper Burmah, Major T. Gracey, R. E., made over charge of the Office of the Engineer-in-Chief and Assistant Secretary, Railway Branch, North-Western Provinces and Oudh, on the afternoon of the 31st March 1887.

Irrigation Branch.

Mr. N. F. McLeod, Executive Engineer, 4th grade, temporary rank, Meerut Division, Ganges Canal, is granted eighteen months furlough out of India, together with the usual subsidiary leave.

Bombay, April 7, 1887.

Mr. C. T. Burks, B.E., M.I.C.E., Executive Engineer for Irrigation, Poona, is appointed to act as Executive Engineer, Poona Districts, in addition to his own duties, during the absence of Mr. Howard on privilege leave, or until further orders.

Burmah, April 2, 1887.

The services of Mr. J. Mackenzie, Honorary Assistant Engineer, have been temporarily placed at the disposal of the Marine Department for employment in Upper Burmah, with effect from the 21st March 1887.

Mr. P. B. Roberts, Executive Engineer, 2nd grade, in charge of the Taungdwingyi and Thazè road, is appointed to the charge of the Taungdwingyi division.

Mr. F. Sharp, Executive Engineer, 4th grade, is appointed to the charge of the Minbu division.

With reference to *Gazette of India* Notification, dated the 16th March 1887, Mr. F. Sharp, Executive Engineer, 4th grade, reported his arrival at Rangoon on the forenoon of the 11th idem.

Burmah State Railway.

With reference to Director-General of Railways' Notification, dated the 10th instant, Mr. E. F. Gordon, Assistant Engineer, 1st grade, reported his arrival at Rangoon on the forenoon of this date and is posted temporarily to the 1st division, Toungoo-Mandalay Extension.

Mysore, April 2, 1887.

Mr. B. P. Raghavalu Naidu, Assistant Engineer, Shimoga Division, is granted one year's special leave, without allowances, under Section 134 of the Civil Leave Code in extension of the leave sanctioned in this Office Notification No. 398—62, dated 31st January 1885.

The services of Mr. W. McHutchin, Executive Engineer, Mysore State Railway Surveys, having been temporarily placed at the disposal of this Department, he is posted to the Palace Division.

Hyderabad, April 1, 1887

Mr. A. F. Higgins, Executive Engineer, 2nd grade, is, on return from privilege leave, placed under the orders of the Superintending Engineer for the purpose of drawing up the projects for the water-supply of the towns of Shegaon and of Akola in the Akola District.

Bengal, April 13, 1887.

Establishment—General.

Baboo Baroda Prosad Bosu, Executive Engineer, 4th grade, sub. *pro tem.*, lately attached to the Rajshahye Division, is granted sick leave for six weeks, in extension of that granted in Bengal Government Notification of the 7th ultimo.

Establishment—Irrigation.

Mr. C. W. Odling, Superintending Engineer, Class III (temporary rank), in charge of the Sone Circle, is granted privilege leave for three months, with effect from the 12th instant, or such subsequent date as he may avail himself of it.

In modification of Bengal Government Notification of the 23rd ultimo, Mr. C. E. Livesay, Executive Engineer, 2nd grade, Nuddea Rivers Division, is granted privilege leave for one month, with effect from the 15th May 1887.

Indian Engineering Patent Register.

SECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

March 9, 1887.

157 of 1886.—Thomas Russell Crampton, of No. 4, Victoria Street, in the City of Westminster, England, Civil Engineer —*For improvements in railway wheels, or wheels for vehicles running upon rails.*

229 of 1886.—Dadabhoy Bomanjee Mistry, of Bombay, Parsi Inhabitant, Mechanical Engineer, residing at No. 8, Mazagon, without the Fort of Bombay.—*For improvements in rotary oil mills.*

18 of 1887.—William Bull, Civil Engineer, of Southboro, Tunbridge Wells, England, at present residing in Allahabad.—*For improvements in roofing.*

49 of 1887.—Morris Lachman, residing at No. 1810, Laguna Street, in the City and County of San Francisco, and State of California, one of the United States of America, Merchant.—*For certain improvements in sewing machines.*

50 of 1887.—Alexander Bernstein, of 9a, Commercial Road, Pimlico, in the County of Middlesex, England, Electrician.—*For improvements in automatic electric cut-outs.*

SELECTED ABSTRACTS OF RECENT BRITISH SPECIFICATIONS.

"Improvements in Propellers."—No. 541.—*A. F. Yarrow* (Yarrow and Company), London, England. Application filed, 13th January 1886. Patent sealed, 7th January 1887.

This invention relates to an improvement in that form of screw propellers, wherein the screw is encased in a tube and its propelling efficiency augmented by means of guide blades placed aft of the propeller.

With such propellers difficulty is experienced in going astern, and the object of Mr. Yarrow's invention is to overcome this difficulty.

The screw blades, which are fixed to a central boss on the screw shaft, rotate within a circular casing projecting some little distance both fore and aft of the blades. Tapered continuations of the boss are fixed to such fore and aft projecting parts of the casing by means of guide blades, which are radial to the boss and straight in a fore and aft direction, so that the stream coming from the propeller, either ahead or astern, is prevented from rotating on leaving the apparatus, and it is stated that practically no efficiency is sacrificed in going ahead while a greatly increased efficiency is obtained for moving astern.

The inventor's firm are well-known as makers of fast torpedo launches, and the drawings attached to the specification represent the invention as applied to such vessels.

"Improvements in Flushing Cisterns."—No. 407.—*G. Jennings, S. Jennings & J. Morley*, of Lambeth, London, England, Sanitary Engineers. Application filed, 9th January 1886. Patent sealed, 14th January 1887.

The inventors are members of a firm which has gained a wide reputation for the manufacture of all kinds of sanitary engineering appliances. Their present invention forms a water-closet flushing-cistern of somewhat complicated construction, but with several apparently good features.

The cistern is divided into three compartments, in one a ball valve is provided for supplying water to the apparatus from the main or other source of supply. The water passes from the first compartment to the second, by a passage through the bottom of the former and in connection with this passage a valve is provided. The second compartment contains the maximum quantity of water to be delivered by the apparatus. This compartment has in the bottom, a delivery passage of large area, also provided with a valve. Immediately beneath the second compartment is the third compartment, of sufficient capacity to contain water for an after-flow.

This third compartment has an outlet valve immediately beneath the valve of the second compartment and the lower valve has a passage of large area through it, continued up to such a height, that when the valve is on its seat the after-flow compartment can be filled. These valves are all closed by their own weight and have rods connected with levers adapted to be acted upon by tappets upon an axis. The rod of the main delivery valve, or that which allows the water to pass out from the second compartment, is hollow; and the rod of the after-flow valve passes up through it.

The above-mentioned axis is partly rotated to bring the apparatus into action by a pull wire or other connection, while a counterweight causes it to return. When the axis is turned, by such pull wire or other connection, the tappets first permit the valves in the first and third compartments to drop to their seats, so that no more water can pass into the second or main flushing compartment and the after-flow compartment is ready to retain water. Immediately afterwards the movement of the axis causes the main flushing valve to be opened and water rushes rapidly out of the main compartment. Some of the water passes down by the passage through the after-flow valve, and this forms the main flushing supply, whilst the remainder of the water, missing this passage, is retained in the after-flow compartment. On the pull wire being released the axis returns to its original position, the after-flow valve then lifts, allowing the after-flow water to pass away, so that this water enters the closed pan, after the pan valve is closed, and there remains. During the return of the axis also the main flushing valve closes and the valve, by which the second compartment fills, opens and allows water to pass into it from the first compartment to which a further supply comes from the main.

SELECTED ABSTRACTS OF RECENT INDIAN SPECIFICATIONS.

Motor Engines worked by Combustible Gases or Spray.—14 (1885).—*Gottieb Daimber.* Relates to an improved construction of that class of Motor Engines worked by combustible gases or petroleum vapour or spray, wherein a combustible charge is only introduced at every alternate instroke of the piston, the improvements being such that the gaseous charges employed are of greater volume and are freer from products of combustion than those of engines hitherto constructed.

This is effected by introducing into the cylinder both before and after the admission of the main charge of gaseous mixture additional charges of either combustible mixture or of air, introduced at every stroke by means of a pump formed in the working cylinder on the side of the piston opposite to that on which the charge works. By one of these additional charges the products of combustion are at the same time driven out of the cylinder. The ignition of the charge is prevented from taking place until the crank is at the dead centre, by causing an explosive mixture poorer in gas than the cylinder charge to come in contact, when compressed with a heated part of the admission passage, the moment of ignition being regulated by varying the proportion of gas in the igniting mixture.

The Prevention of the shrinking of Flannel Shirt Collars by washing.—100 (1886).—*Ross Willaume Hayter.* A metal collar with stud attached, made in various sizes from 14 to 19 inches in circumference, and from 1¼ to 2½ inches, in width either painted, japanned, or covered with leather or cloth of any sort. The collar of the flannel shirt is to be buttoned on to the stiff or metal collar and secured in its place by the fixed stud which goes through the button holes of the shirt collar. This is to be done after washing, but before drying; in fact, the flannel shirt is to be dried with the metal collar fixed in position as explained above, and the stiff collar is not to be removed until the shirt is required for use. The washer brings home the flannel shirts with the stiff collars fixed in position, and it will be found that the shirt collar has not shrunk at all, so that great comfort and economy are the result. This prevents loss of temper and general irritation. The shirts last very much longer and have not to be discarded before they are half worn out. This invention should increase the sale of flannel shirts, as many will purchase now, who would not before, on account of the discomfort of a shrunk tight collar.

Notices.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Answers to Correspondents.

A. E.—Many thanks for your suggestion, which you will see has been adopted.

Obituary.

BROWN.—March 18, at Kensington, George Brown, late of Madras, Indian State Railways, aged 58.

INDIAN ENGINEERING.

SATURDAY, APRIL 23, 1887.

THE PUBLIC SERVICE COMMISSION AND THE PUBLIC WORKS DEPARTMENT.

THE labours of the Public Service Commission would be a very interesting subject of study, if it were more of a record of facts and less of a mere register of opinions. Even to the casual reader who skims over the columns of the heavy reports that have regularly appeared in the dailies, it is quite apparent that in the majority of instances the witnesses said what they would wish to see done rather than what exists in reality. And this peculiarity is nowhere so glaring as in the evidence tendered before the Sub-Committee in connection with the Public Works Department and the Railway Service. It will be no easy matter ultimately to divide the wheat from the tares, and endorse any recommendation of a scheme, from a mass of conflicting statements such as have been taken down from day to day in remote corners of the Empire. To evolve order out of this chaos will be the work of a modern intellectual Hercules, considering how competent authorities from whom a similarity of opinion might have been expected under the circumstances, have flatly contradicted one another in one and the same subject. The views of each individual have received a colour from his immediate surroundings and prejudices.

To take a few out of several instances: Colonel Swetenham Superintending Engineer, N.-W. P., who was born and educated in England, was among the earliest batch of those who passed through the Thomason College at Roorkee, and he naturally claims it as his *Alma Mater* in engineering connection. He has been for upwards of thirty years in the Army, but has remained in the P. W. D. ever since he left College. He says in his evidence: "The best Engineeers, he thought, were those turned out by Roorkee, because they had at the outset a knowledge of the country, people, and language, and were also accustomed to the climate. These qualifications the Cooper's Hill men did not possess till some time after they came out: but when they acquired them, they were as good as the Roorkee Engineers. The opportunities for gaining a practicnl knowledge of their work were similar in both instances, for each college enabled its students to study practically such work as that entailed in bridge, road and railway construction. . . . . . . Morally there was very little difference between the Roorkee and Cooper's Hill men: and the former, so far as Europeans and Eurasians were concerned, were quite equal physically to the latter." With the deference due to such an authority, we feel inclined to dissent from him in the opinion that the two classes of young men had equal opportunities of learning the profession. Whatever might be said of isolated cases of grand engineering works in this country there cannot be a doubt that both in variety and in the intricate nature of such undertakings the palm must be yielded to the old country, and, therefore, to those who have had the advantage of an English training.

Now let us see what another witness who came immediately after Colonel Swetenham has to say on the subject. Colonel Corbett, R.E., whose experience of the Department ranges over a period of 20 years, "considered that Cooper's Hill men were decidedly superior to the Roorkee men, though the former were not so useful as the latter to their Executive Engineers in the first year or so. He could not say which were the best workers: he had met a large number of each class, and they worked equally well, but the Cooper's Hill men were more efficient on the whole. Witness was of opinion that Engineers from a variety of schools for training would be an undoubted advantage, as this plan would obviate having only one type of Engineer in the service." He does not speak very hopefully of the "Stanley" men, for while admitting that some of them—"those first appointed—were very good men indeed; there had been a deterioration in this class of Engineers in recent years."

Mr. Alexander Grant, an Executive Engineer and a "Stanley" man, in the course of his evidence stated that, "he had both Roorkee and Cooper's Hill men under him: there was no difference in the best men of each class; but on an average the latter were undoubtedly the best. Their general education made the Cooper's Hill men superior to the Roorkee, and they were more efficient for irrigation purposes, having more energy, character and self-reliance: of course some Roorkee men had these qualifications in an equal degree, but he referred to the average."

"Who can decide when doctors disagree!"

Whichever way the truth may be, there is no doubt that fairly considered the general advantages enjoyed by the two sets of men are pretty evenly balanced, for while, on the admission of their advocate, Cooper's Hill men have had opportunities of a better general training, the *alumni* of the Indian colleges are already accustomed to the climate, with the additional gain of a thorough knowledge of the ways, habits, and manners of the people of the country and of their language. In instituting a comparison between them we should not be unmindful of the fact that such of the lattter as obtain employment under Government are the cream of the Indian Engineering colleges. We regret to observe that a good deal of sentiment and prejudices have been permitted to obtrude themselves in the evidence tendered before the Sub-Committee. There is a tendency underlying to raise one class and establish its superiority over, and in disparagement of, another class of workers, in a different field, although included in the same Department. We fail to see how it can achieve the purpose of either enlightening the public or throwing fresh light on the subject under investigation. People will, as a matter of course, be chary of accepting opinions inspired so largely by a sense of self-importance, and to the detriment of others. These do not bespeak a healthy condition of the Department and are completely out of place in a serious discussion of some of the burning questions of the day. If, however, we look beyond skin deep into the matter, the cause of this widespread irritation will be found in the unequal treatment of the members by Government, and the effect it has in destroying that *esprit de corps* which is the backbone of the service and the absence of which is the bane of the Department.

INDIAN RAILWAYS.

We are glad to observe that the subject of the extension of railways in India has during the last few months attracted a good deal of attention at Home. Within the first quarter of the current year three gentlemen of recognised reputation, and whose opinions are certainly entitled to a hearing, have been addressing important meetings and societies on the development of Indian railways. First came Mr. Holt S. Hallett, who read a Paper before the Society of Arts, on extending the Burmese railways and connecting them with the Assam lines across the hills to the Brahmaputra. Next followed Mr. J. K. Bythell, who addressed the Manchester Geographical Society on the construction of additional lines, taking as his test the advantages conferred by those already in existence. And now comes Mr. J. S. Jeans, Secretary of the Iron and Steel Institute, who spoke on the same subject before a large and influential gathering of the members of the East Indian Association of London and others, on the 16th of March. Earl Granville, who took the chair, put the question in a clear light, by stating that there were three or four great points for consideration—firstly, whether it is to the advantage of the people of India and to her trade that there should be an extension of railways; secondly, how far such extension would affect the prosperity of English trade; and, thirdly, whether railways in India are likely, as they get developed, to bring profit, not only to those who construct them, but, of course, connected with that point, how far they are likely to be remunerative to the shareholders. It may be premised here that the first two questions have been already and repeatedly answered in the affirmative, by everyone who has bestowed a moment's reflection on them. They are in fact self-evident, and to harp upon a twice-told tale would be equivalent to uttering a platitude, that ought, certainly, to have no place in the discussion of a grave subject, so intimately connected with the social, moral and material development of India. We admit this, and much more, but the question of questions is, how is the capital to be raised for the purpose of conferring all these benefits, with special reference to the fact that England is also to participate in them? We are forced to confess that this intricate problem is as far from solution as ever. It is a veritable hard nut to crack, and it is to be regretted that Mr. Jeans does not help us in removing the difficulty.

Without wishing in the least to disparage the utterances of Mr. Jeans, for whom we entertain great respect, we cannot help arriving at the conclusion, that in the majority of instances, the speeches and writings of Englishmen unacquainted with this country prove two indisputable facts—(1) that the economic conditions of India are a sealed book even to the educated portion of our countrymen and (2) that facts and figures are unconsciously misrepresented in support of a plausible theory.

Mr. Jeans followed up the Chairman's remarks by an attack upon the Indian Government and quoted what he called "an ominous passage from the financial statement for 1886, in which it was announced that the Government were obliged to abandon, for a time, the expenditure of any money on railway development other than £500,000 received from the famine grant." Now it is no secret that this policy has been forced upon our rulers, owing to the loss of exchange, which, during the last three years, has steadily added over a million and a quarter sterling annually to the public expenditure. With this fact staring the speaker in the face it is rather unreasonable to maintain that "the wrong scape-goat had been selected. India had found it difficult to meet the additional loss of exchange, and the cost of the special war arrangements, because she was so poor. The remedy was first to cure that disorder." Had his remarks been confined to the waste of public money involved in the protection of our 'Scientific Frontier,' there could be no room for dissent; but when he tries to dispose of the grave problems of Indian exchange and currency, the reader cannot divest himself of the idea that he undertakes to handle a subject of which his knowledge is limited. We feel disposed to believe that if Mr. Jeans' remedy is applied to the Indian finances, the charge which he brings against Government, that it was just as sensible to argue that the only possible way of recovering a heavy loss was to take steps to make another, recoils on himself. Does he suggest a relief for the disorder into which the exchequer has fallen? None whatever. On the contrary, he speaks so confidently of raising and expending extra millions of money, as to give rise to the impression that several sources of income to the Indian Treasury are yet open and the Government was guilty of culpable neglect in not taking advantage of them. Whereas if the truth were told, all the means at its command have been sorely tried and exhausted, whether in the shape of direct or indirect taxation, and the country is already groaning under a heavy burden. The imposition of the income-tax, and the resistance it encountered throughout the country, showed but too clearly the temper of all classes of the community, in regard to further taxation, and if any fresh attempt were made in that direction, it would prove to be the proverbial straw that broke the camel's back. The question that now remains to be considered is, how is the capital to be obtained for the extension of railways? We propose to deal with the subject in a future issue.

THE BRITISH IRON TRADE.

The year 1886 has been very far from a satisfactory one to those whose incomes have depended in any way upon the iron and allied industries of Great Britain. The employment afforded to all classes of operatives has been much less, and lower wages than have been known for many previous years have been paid. Nor have capitalists fared any better; for the average profits distributed have been very small, and in many instances they have been nothing at all.

The output of the three principal iron producing centres, namely Scotland, Cleveland, and Barrow in Furness, have continued to decrease. Only 205 furnaces were in blast on the 31st December, against 232 a year before. The average price realized by Scotch pigs during 1886 was 39*s* 11*d*, or 2*d* less than it was in the year 1851, which is the lowest previously on record. Notwithstanding the decreased make, and extremely low price, the stocks in the three districts named increased during the year by 249,413 tons. The exports for the year were 3,389,197 tons, valued at £21,722,951, against 3,128,401 tons, valued at £21,717,136 in 1885. To put it in another form 260,796 tons more were exported in 1886 than in 1885 for about the same amount of money.

The fluctuations in the British iron trade have for long been due in no small degree to the commercial policy of the United States. If free trade principles prevailed there, things would find their level, from time to time, without so much disturbance of the course of trade. But with protective principles strongly upheld, with a tariff which has frequently been altered in the past and which is constantly liable to further alterations to deal with, British producers scarcely know what to do. The demand which has now set in is only, as it were, an overflow demand, and cannot be reckoned upon as a permanency. Neverthless, it appears to be a very solid and substantial demand, indicating great prosperity across the Atlantic, and it may last for a considerable time. At any rate, it is of the utmost importance for those engaged in the British iron trade to watch always closely the course of events in America, for be the cause what it may, the rise and fall of trade in the United States seems always to be the precursor of similar movements in all the other countries of the civilized world.

Although the home and general shipping trade for last year fell considerably short of previous records as to quantity and price, yet the improvement in the American demand during the last few months of the past year has been so distinct and so great, that the exports from the old country in rails, blooms and old materials amounted to 540,000 in 1886, against 173,000 tons in 1885. It is this fact that has just created so great a change in the present tendency of the iron market. Keeping in view, however, the extreme improbability that this demand will continue permanently in face of the great power of expansion which we know Americans possess, it is to be hoped that English producers will be wise enough to refrain from building new furnaces and works, as they have done under similar circumstances in times past; and it is further to be hoped that British workmen will not interfere, by strikes and idleness, with the good chance which is now offered of earning money for the general good of the nation, and making up for past losses. It is a noteworthy fact that not only the Americans, but the Germans also have suddenly reappeared in the British iron market. This was quite unexpected especially as the buyers in the latter case are in almost all cases steel makers.

Notes and Comments.

Bengal Administration Report, 1886-87.—We glean from a review of official progress during the past year in Bengal that but little could be done in the way of opening new lines of railways; the policy adopted by the Executive was rather the concentration of expenditure upon nearly completed sections than the extension of work over new projects. In Public Works there was a considerable reduction of expenditure on Imperial resources, but the total Provincial outlay amounted to almost the same as in the previous year.

A Gloomy Prospect.—Sir Steuart Bayley's speech at the unveiling of Sir Ashley Eden's statue in Calcutta on the 15th instant, is not encouraging to those who have hoped for the development of Public Works in Bengal. The re-arrangement of the system under which the Provincial Contracts were formerly regulated, however necessary in Imperial interests, has been fatal to Bengal. For the past five years Bengal has had starved allotments, and reductions of establishment; and we understand that the year to come will be no exception to the rule.

Coal of Borneo.—Steam-ship companies trading to the China seas have long been anxious to obtain coal of a suitable quality in those parts, not only for the purpose of economy, but to prevent so many vessels that come out laden with coal, competing for freight on the homeward journey, and thereby reducing the rates until it hardly pays the fast steaming passenger vessels to carry cargo. In Sarawak workings are to be commenced while those of Labuan are to be revived, and in the Dominion of the new Company the mineral prospects are more than encouraging.

Rai Bahadur Kanhya Lal, M. I. C. E.—In mentioning former students whose careers have been honorable to themselves and a credit to "Roorkee", Colonel Lang says, in his recent address at the close of the Thomason College Session, I must not omit Rai Bahadur Kunhya Lal, who long ago acquired his reputation as a distinguished practical Engineer in the Punjab, and a writer on Engineering in India. His name will always be associated with the College in connection with the handsome medals which he has founded, and the prizes which he generously gives annually to Native Students.

North-West Australia.—By last advices from Kimberley in W. Australia, there was every prospect of the gold fields there proving permanent. At least during the present wet season, their claims to permanency will be fairly tested. At the end of last year, several rich leaders had been discovered. One digger obtained specimens weighing 2lbs. and 3lbs respectively, and encouraging reports were continually being received at the nearest seaport to the fields. On one reef a shaft, 40 feet deep, had been sunk. The stone turned out to be 5 feet in width showing gold all through. The auriferous district was being thoroughly tested.

Coal in Central India.—The *Bombay Gazette* asserts that the Warora colliery yields a net profit of about Rs. 1,00,000, which is equal to something over nine per cent. on the capital. We are disposed to question the accuracy of this statement, and doubt whether the great outlay incurred by Government in connection with the exploration and testing of this coal-field will ever be recouped. The poor quality of the mineral coupled with the serious flooding of the mines in 1879 and the firing of the mines in 1882 are facts of which our contemporary takes no cognizance, and we might add that the preliminary expenditure alone at Warora exceeds the average capital of the Bengal Coal Companies.

Construction of Telegraph Wires.—In connection with our observations on the regular break-downs of the Indo-European Telegraph Lines during the heavy snow and storms of Persia, we learn that there is another cause of injury to which they are subject by exposure which has not yet received as much attention as it deserves. This is the great shrinkage of the wires caused by heavy rains, snow, or excessive moisture. In countries where there are long lengths of wire the aggregate shrinkage is enormous. This contraction causes the pulling apart of wires at joints through the strain caused by the lessening of length. The shrinkage also disarranges and necessitates a re-adjustment of the balance.

A Hard Hit.—The Madras Chamber of Commerce declares in its summary of Proceedings in 1886 that the Department of the Consulting Engineer for Railways seems to the Chamber to be in much need of retrenchment. It points out that the Railways are officered by experts who have acquired practical experience of far greater value than the theoretical knowledge of the officers referred to; but the Government seems to distrust their ability, or honesty, and does not hold direct communication with them. As the existing arrangement is fruitful of circumlocution, of divided responsibility, and of unnecessary expense, the Chamber proposes it worthy of reconsideration by the Executive.

Ceylon Railways Extension.—Mr. Prestage offers to construct a 2½ feet line to Badulla or anywhere else in Ceylon; and the rate he asks for a mile of a 2½ feet line is £6,350, which at the current rate of exchange in London is Rs. 89,482. From data derived from the working of the Darjeeling line, which is on a still narrower gauge than that which he proposes to build in Ceylon, he has conclusively shown that the prospects of the line he advocates for that colony are encouraging. The Darjeeling line runs round curves of as great a radius as 42 feet; up inclines 1 in 35; and one engine draws paying loads of 50 tons at a speed of 10 or 12 miles an hour up those inclines round those curves. The physical difficulties to be overcome in Ceylon are comparatively, with these figures, small.

Sir Ashley Eden's Statue in Calcutta.—This fine work is utterly ruined by its surroundings, and is quite out of place in its location. A large equestrian statue would have been more appropriate to the site chosen, for which the Committee are entirely responsible, so that that unfortunate village donkey—the P. W. D.—at which all love to have a kick, cannot be damned on this occasion. A far better arrangement would have been to place the statue directly opposite the centre portico of Writers Buildings, by taking up a small part of Dalhousie Square for the purpose, and making the present boundary of the square the front line of railing to the statue, so as not to interfere with the footpath. At present, though admittedly a fine work of art, the statue looks dwarfed and insignificant.

Extension to the Surveyor General's Office, Calcutta.—The extension to the Surveyor General's Office in Wood Street, Calcutta, which is a most urgently needed work, may possibly be undertaken this year, if funds can be scraped together by any means. It

was originally intended that this work should be carried out immediately after the erection of the Wood Street building, which was completed about 1882; but want of money has hitherto stood in the way, so that the Mathematical Instrument Department and the Photographic Branch of the Survey of India have had to put up with their present wretched accommodation. Year after year this work has appeared in the Budget, as one considered necessary and to be carried out if funds are available. It is to be hoped that something is to be done at last. Better late than never.

THE MOON AND SAP.—The question as to whether it is possible that the moon affects the rise and fall of the sap of timbers, and that the existence of sap attracts rot, causing insects, or fungi, or the reverse, is now under discussion in Southern India, wherein it is asserted that timbers felled during certain phases of the early portion of crescent moon get rotten sooner than those cut down between the close of crescent. Some facts noted in grafting elicited the conclusion that sap is very active and strong in trees and plants for the first two quarters of the moon, and being so active rises vigorously throughout all the branches; while during the two last quarters of the moon, the sap is weak and not so plentiful. It is well known that in parts of India and the Far East bamboos are never cut at certain states of the moon under the apprehension of premature decay.

REDUCTION OF ESTABLISHMENT IN THE BENGAL P. W. D.—Owing to the introduction of the new scheme for the development of Local Self-Government in Bengal, another reduction of establishment in the Provincial and Irrigation Branches of the Public Works Department may be expected. With the exception of Chota Nagpore, all the Bengal Commissionerships either have been already, or will shortly be, provided with Local Inspectors of works; and when the new arrangements are in full swing, most of the Provincial divisons will probably be abolished. This leaves a certain number of men available for transfer to other Branches, or for reduction; and as some years ago a large number of Railway Officers were transferred to Bengal, we presume they will be the first to go and that they will return to their own Branch, in which we understand more men are urgently wanted for work on the Frontier, and in Burmah.

OUR RAILWAY POLICY.—Nothing could possibly be more satisfactory from the point of view of investors, financiers and professional directors than the present railway policy of the Government. The shareholders in the new lines get 4 per cent with a share of profits, the financiers get one per cent on the capital raised, and the directors handsome fees—all without a shadow of risk and "hunky pays." The arrangement is admirably calculated to further the rapid extension of our railway system, and it is only a matter of surprise that we do not adopt this liberal handed policy on all our railways, and moreover cover the land with thousands of miles in the year and fill Lombard Street with joy. There are those who croak about India being a poor country, that the Secretary of State could borrow in London at three and half per cent without paying "a red cent" to financial houses, and that we have on hand a huge staff of railway engineers who will soon be sitting idle. Mere bagatelles! Let us fulfil schedules A and B though the heavens fall.

E. I. R. BURRAKUR BRANCH EXTENSION.—We learn that the proposal to extend the East Indian Railway across the Burrakur to serve the coal field on the west of that river will involve an outlay of about 20 lakhs of rupees. This includes the entire construction of a suitable bridge and the extension of the line to a point five miles beyond. The present Burrakur bridge on the Grand Trunk Road is about half a mile north of the site of that now proposed for the railway. It consists of nine spans of about 153 feet each, of light girders, with 5 land arches of 76 feet span on the west bank, and 2 similar arches on the east bank, and is about 2,100 feet in length over all To render this bridge suitable for railway traffic the superstructure would have to be entirely changed, the new superstructure made wider to provide for both rail and road traffic, and considerable cost incurred in diverting the present line away from the Burrakur station to provide a proper approach, entailing the probable abandonment of the station.

THE GOVERNMENT OF INDIA P. W. D. SECRETARYSHIP.—Speculation is again rife regarding the Secretaryship to the Government of India in the Public Works Department. The result is expected to be published very shortly, and the announcement may even be made before this number of our journal appears. Opinions are about equally divided between Colonel Pemberton, R.E., and Colonel Filgate, R.E. The former is the senior officer in the Department, and should on every ground get the appointment, but unfortunately this is probably the very reason why he will not obtain it. If, however, Colonel Pemberton is made Secretary, Colonel Luard will probably succeed him as Director General of Railways. Colonel Filgate is quite the right man in the right place as Accountant General; but having deliberately chosen the Accounts side, he should remain in it. We can imagine the roar of derision which would greet a proposal to appoint (for example) a senior Civilian 1st Grade Examiner of Accounts—who had had a few months experience as an Assistant Engineer at the outset of his career—as Secretary to the Government of Bengal in the Public Works Department. And yet this case is exactly parallel to Colonel Filgate's, substituting Bengal for India. *Mutato nomine, de te fabula narratur.*

TOUNGHOO AND MANDALAY STATE RAILWAY.—Work on the Tounghoo and Mandalay State Railway is not progressing so favourably as it might, though it is only fair to say that this is not due to any fault on the part of the officers in charge of the line. Want of labour is the real cause, and Jack Burman, as is well-known, will *not* work. He even refuses to sow or reap his own crops if he can possibly help it. Every year, thousands upon thousands of Chittagonians travel down the Arracan coast, to plough, sow, and reap for the Burmese cultivator, earning from twelve annas to one rupee per day for their labour. The Railway therefore is being constructed by means of imported Indian labour, and until confidence is restored, this is likely to be somewhat scanty. Even now working parties have to be protected by guards, for fear of attacks upon them by docoits. The earthwork in embankment, however, is being pushed on as rapidly as possible, leaving the cuttings to be carried out during the rainy season. The *Indian Daily News* published a paragraph a few days ago, that Mr. T. E. Owen, an Executive Engineer on this line, was said to have been captured by dacoits, but the fact of the rumour not having been confirmed leads us to hope that it is not a true one.

Current News.

THE sum proposed to be expended on the improvement of the water-supply of Bangalore is Rs. 33,000.

THE grievances of the officers of the Telegraph Department are attracting considerable attention at home.

THE state of the Irrawaddy is causing anxiety at Mandalay. It is only from two to three feet deep a few miles above Mandalay.

A HILL sanitarium as a cantonment on the plateau of Imjok, near the Ruby Mines, is being laid out, and barracks are to be erected there.

THE Mhow Water Works Division, formed on the 16th July 1886, is now abolished as a separate executive charge, with effect from the 1st April 1887.

MR. SMEATON, Director of Agriculture, has made over charge of the Agricultural Department of the N.-W. Provinces and Oudh to Lieutenant-Colonel Pilcher.

Mr. E. C. Ozanne acts as Survey and Settlement Commissioner in Bombay during the absence, on leave, of Mr. H. Stewart, and Mr. J. A. Baines acts as Director of Agriculture.

MR. LIND BUYERS, Engineer of the Southern Mahratta Railway, leaves for Dharwar to complete contracts for the construction of the Gubb-Hurrihur Section of the Mysore Railway.

THE story of a Public Works Engineer having been bitten by a *Krait* and heroically submitted to having his hand chopped off to escape death, was incorrect in some of the principal details.

THERE are some very fine Road Avenues in Mysore, and according to the last report by the Inspector-General, the total length of roads in the Province planted with trees is a little over 4,000 miles.

LAST week there was rather a serious accident on the Lucknow-Sitapur Railway, some two miles from the latter station, resulting in the death of two, if not three, men, and severe injuries to others.

MR NEWTON, Resident Engineer at the Ganges Bridge, who is one of the oldest residents of Cawnpore, is shortly leaving to enjoy well-earned rest at home. In him the station loses a first-rate Engineer.

AN extensive fire occurred at Delhi on the 13th instant morning. West's Patent Cotton Press, the engineer's house and a large number of huts were burned down. The damage is estimated at Rs. 30,000.

A FIRE broke out in the Rawal Pindi Arsenal, Miscellaneous Stores Department, on the morning of the 13th instant. Quite two lakhs worth of general stores were burnt. The origin of the fire is unknown.

THE average time occupied in the transmission of messages from Calcutta to the United Kingdom by the Indo-European Telegraph Company during the first fifteen days of April was one hour and 47 seconds.

THE Tank Maintenance Scheme branch of the Madras P. W. D., which had been doomed by the Finance Committee, has got another lease of life granted to it, but under greatly reduced and modified conditions.

WE understand that when the arrangements for extending the supply of filtered and unfiltered water to the suburbs of Calcutta are completed, the opportunity will be taken to supply the Presidency Jail daily with sufficient for all the prisoners.

EXPERIMENTAL plantations of India-rubber, mahogany, and the Arabian date, which were opened out last year in Bangalore by the Superintendent of the Lal Bagh, have progressed very favourably, and the Mysore Government are extending them.

THE extension of the line to Batinda on the Rewari-Ferozepur Railway is still under the consideration of the Patiala Darbar. It is, in fact, under survey at the present time: and the powers to construct it will be applied for when the survey is completed.

THE Dehra Dun Railway scheme does not appear to progress much, and it is on this account that a Joint Stock Dâk Company is being projected by some of the principal residents. Messrs. Buckle and Co. are to be Managing Agents of the new Company.

MR. H. F. BLANDFORD, Meteorological Reportor to the Government of India, takes furlough shortly, and will probably be succeeded by Mr. J. Eliot, Meteorological Reporter to the Government of Bengal, who has acted for Mr. Blandford on previous occasions.

HER MAJESTY'S Secretary of State for India has accorded sanction to the Revised Estimate of the cost of constructing the Sind-Sagar System of Railways, amounting to Rs. 2,87,50,000, including Rs. 22,00,000, the original cost of the metre gauge line from Miani to Bhera.

THE undernamed Royal Engineers have been transferred from the Madras to the Bengal Presidency, attached to the Military Works, and posted as follows:—Lieutenant A. L. Swainson, to Sibi; Lieutenant H. J. Sherwood, to Fort William, and Lieutenant H. C. Nanton, to Saugar.

THE Provincial Railway survey in the Bombay Presidency is again to be abolished as a measure of economy, though not until it has completed its field work with the plans and estimates. The complaint is made that there are still a number of railway projects unsurveyed, especially the proposed line to the new dock at Hog Island.

LORD DUFFERIN visited the Canal factory and workshops at Roorkee and was much interested in the good work there carried out by the native workmen, especially in the manufacture of surveying and mathematical instruments. Thence His Excellency proceeded to the Solani Aqueduct, one of the greatest engineering works of the Ganges Canal.

WE hear that a graduate of the Punjab Universtiy has been appointed a probationer in the Meteorological Department at Simla, and that on the expiration of the period of probation, he is likely to be appointed second Assistant to the Meteorological Reporter to the Government of India, *vice* Mr. Loocheeram Shani, also a Punjaubee, reverted to the Punjab Education Department.

IT having been found that the conditions required by the Government of India in the case of the opening of a new line of Railway had not been fully met in regard to the section of the Bellary-Kistna State Railway, from Guntakal to Nandial, and Colonel C. J. Smith, the Consulting Engineer for Railways, has had to intimate that it will take two months before the line can be thrown open to traffic.

BESIDES the technical education scheme, there is a proposal, we hear, to abolish certain classes of the Calcutta Presidency College and to create a few chairs of Science Professorships out of the savings to be thus effected, for the purpose of preparing the graduates of the University for Professorships in District Colleges. It is also said that classes for carpentry, tin, iron and brass-smiths will be opened experimentally in connection with the College.

THE Pachodra and Umarkot route is one of several Railway lines that compete for official sanction. One line has been projected from Palhanpur to Haidarabad viâ Deesa. This, it has been roughly estimated, would cost a little over three crores. For another the route marked out is from a point on the B. B. and C. I. Railway near Wadhwan, through the State of Kutch, to Haidarabad. This line, like the other, crossing the Indus on a bridge which would cost fifty lakhs, and joining the North-Western State Railway at Kotri.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

THE SIND-PISHIN RAILWAY SCANDAL.

SIR,—"C. E.'s" letter in your issue of the 26th March relating to the so-called Sind-Pishin Railway scandal is pitiable. The construction is said to be faulty, but no points are mentioned. Concerning the expenditure, I think a rupee a day is above the average paid for coolie, *i.e.*, *manual*, labour in India.

SHARIGH; *April* 14. MILITARY.

THE SAIDAPET FARM, MADRAS.

SIR,—I was sorry to read your para about the Saidapet Farm. I enclose a copy of a work showing some of the results of the farm, and I send also a copy of the last report of the Executive Department, proper, which took the place the farm filled. You will see how very imperfectly the work is now done under the present *regime*, which has been at work for *three years*, but being composed of *Covenanted Officers*, of course, whatever *they do must* be right! No U. C. S. officer can do anything well!!

But the Saidapet Farm has *not* been abandoned. It is still under the charge of the Principal of the Agricultural College and has been since September last, as a College Farm. But it is *no longer* under the control of a Board and Covenanted Officers. The Farm was always considered the *Agricultural Department* of S. India, and as such *bore all the cost of all Government operations in all parts of the Presidency:* the Farm *itself* never cost Government Rs. 500 in any one year. VERITAS.

[The papers referred to support the contention of our Correspondent and throw a different light on the subject to that of the G. O. on which our Note was based.—ED., *I. E.*]

GARSON'S PATENT STIFFENED SUSPENSION BRIDGES.

SIR,—Our attention having been called to remarks by "F. E. R." on these Bridges which appeared in your issue of 12th March, permit us so state in reply—

Firstly.—The top centre link is loose, being placed there merely to improve the appearance.

Secondly.—The resultant strain of 3·25 tons on the pillars is shown *repeated* in the diagram and both should be added together.

Thirdly.—The strength of the connection of the top bar F referred to will be found to be ample, the pressure being less than 4 tons on the square inch sectional area of the pin, on account of the latter being in *double shear.*

Lastly.—The subject of the "Patent" is not of course the general principle of the construction of this Suspension Bridge which is not patentable, but the special application of its principal details, so as to render such a system of construction more suitable as a permanent structure and not merely to be available for "Field purposes."

We may add that one of these Bridges constructed for the Darjeeling Road Cess Committee was tested lately at our Works, and gave most satisfactory results.

GLASGOW; *March* 24. A. & J. MAIN & Co.

UNFAIR COMPETITION.

SIR,—I was very pleased to see in the *Civil and Military Gazette* that a movement is on foot in a most important matter affecting a large class of professional men in this country, who are rendered helpless, by the very arbitrary manner in which the R. E.'s who

are masters of the P. W. D., send P. W. officers to fill every post in private undertakings. This is a most shameful proceeding on the part of those who allow it. I have suffered much for the past five years, on this very account, and still suffer by it. As soon as I became aware that the Gwalior State intended to establish a D. P. W. of their own, I immediately applied to Sir Lepel Griffin for a post; he forwarded my application on to a Mr. Harris, Superintending Engineer of the new department; I do not at present know who he may be, a D. P. W. officer or an outsider; however, a long correspondence passed between us, but it came to nothing. Nothing tangible, or definite, was mentioned in his letters, all I could make out from them was that the terms I asked were too high. I believe all this to be subterfuge, and I can only say, that if the unemployed Engineers in this country allow such private appointments to be misappropriated for the want of a little combination on their own part, they can only blame themselves for being shut out from all employment—both private and public. They should bear in mind that the Nagpur-Bengal line is about starting, and already a Coopers Hill man, a third grade Executive Engineer, of about 34 years of age, has been appointed Chief Engineer of the line. This looks as if other Engineers of the D. P. W. will follow suit in the lower grades. We have only to cast our eyes at the I. M. Railway to see how outsiders have been shut out from that work; and the same will be the case on the *new* work if immediate means are not taken to protest to Government before it is too late It is the same thing all over the country. May I ask you what all the Engineers of the Madras P. W. D. that are to be sent adrift shortly are to do? Government should be reminded of this, and be asked to leave all private companies and works to these, or what will be the result to the unfortunates and their families?

J. I.

GOVERNMENT *V.* PRIVATE ENTERPRISE.

SIR,—The Engineering trades of India have a real grievance against the State in the matter of open competition with private enterprise, and though volumes have been written on the subject the oracle will neither hear nor speak. Turn whichever way we may our auditories are invariably assailed with rueful words, "the Indian trade is ruined," "India is not what it was 20 years ago," "Trade is in a bad way," and so on. The complaints are so general and yet so specific in character that those disposed to be sceptical need only institute private enquiries with a view to ascertain their correctness, and the result, we are sure, will not only confirm this, but disclose an extent of genuine dissatisfaction and injured feeling which should not be allowed to pass unheeded by the powers that be. The gravamen of the charge is centred in the fact that Government is persistent in its efforts to choke and otherwise paralyse private enterprise and has turned a deaf ear to reports and representations made from time to time The interested public would have Government to abandon the present mischievous arrangement of obtaining all its P. W D.—often interpreted as meaning Public Waste Department—requirements. Were the Government so solicitous of economical administration to scrutinise the working of the Stores Department, it would, we are told, find that it costs a great deal more to import through the existing channel (the India Office) than otherwise, through the local firms. Among these latter there are several who are able to meet all Government indents from a *pin* to an *anchor* and that, too, as promptly and efficiently as any Home firm. We have only to point to the Roadway Bridges recently supplied by Messrs. Burn and Co. to the Malabar Local Board, as a proof of such an example.

This is a strong commentary on the conduct of the past and present Governments for their wilful persistence in the pursuance of a policy which, viewed by the light of ordinary understanding, is *morally* and politically wrong, and certainly inconsistent with its *fostering* intentions.

The fact of having encroached too much on your space will not permit our writing much further on a subject whose paramount importance deserves better treatment than we are at present prepared to give it.

LIGHTING RAILWAY CARRIAGES

SIR,—I have read with some interest your notice, in the issue of April 16th, of Mr. Carswell's "Improved System of Electric Train lighting," and I wish to point out the grave objections to this system.

Mr. Carswell proposes to put down a separate plant at each tunnel. It must be obvious that the very small duty required from each plant renders such a plan wasteful to a phenomenal extent, excepting, perhaps, on extremely busy lines passing through but one or two very long tunnels. As for example, that just outside Lime St. Station at Liverpool. In such an exceptional case it might possibly pay to keep an engine and dynamo running continuously all day to light the frequent trains passing in both directions. In the more ordinary case of a number of tunnels of moderate length with only some half-dozen trains passing during daylight, Mr. Carswell's plan would be highly uneconomical. Of course, moreover, the trains would have to be provided with some other illuminant to light them at night when not in a tunnel, and so Mr. Carswell's expensive plant would be idle after dark!

If he collected his generating plant and placed it at a terminus and carried his conducting rail throughout the line, it would be practicable for the guard of a train to light up when in a tunnel or at dusk. This plan has, however, though theoretically good, failed in practice, owing to the great difficulty experienced in maintaining a conductor, capable of making contact with a moving consumer, in a sufficient state of insulation. In India this might not be impracticable, at any rate during the dry weather, especially with a current of low electromotive force; but the English climate rendered the attempt futile. There is, moreover, a source of loss and trouble inherent in any system of ungetatable rubbing contacts.

The other plan suggested by you is a decided advance upon that of Mr. Carswell; nevertheless, there are serious objections to it. The principal drawback to incandescent lamps is their fragility, and the careless handling by railway porters in frequently placing and removing them would inevitably cause a large percentage of breakages. Moreover, the large number of small accumulators needed would be very uneconomical in first cost and working.

There is available, however, a very simple and economical plan of lighting trains by electricity and one that has been successfully used on the London, Brighton and South Coast line in their Pullman car train. In the guards van fix a small dynamo and connect its driving pulley with one of the axles of the van by a belt. In the same van place a small number of accumulators and fix a switch board on the side of the van. Place incandescent lamps throughout the train where needed. It is now a simple matter to so connect the dynamo accumulators, lamps and switch board, that the dynamo lights the lamps when the train is in motion, and charges the accumulators into the bargain, and when the train is standing in a station or elsewhere the accumulators will maintain the lamps in full glow—giving out current in inverse proportion to the dynamo and thus acting as a governor on the dynamo and compensating for any inequalities of speed. Nothing could well be more economical than the above, as when the lights are not required all that is necessary is to throw off the strap on to a loose pulley and break the accumulator circuit at the switch board.

L. A. DAVIES,
Electrician, O. R. R.

BENARES; *April* 18.

Literary Notices.

CHEMISTRY PRIMER. *By Mirza Mehdy Khan, F. G. S., A. R. S. M., Master of H. H. the Nizam's Mint*, Hyderabad—Deccan.

WE have been favoured with a copy of this little book by a friend who believes that its merits have not met with the attention they deserve.

The first and last chapters will give a general idea of the matter contained in it. We mean chapters I. and IX. Of the other 7 chapters 6 (II to VII inclusive) are devoted to the description and treatment of the elementary bodies according to their atomicity—monads, dyads, triads, tetrads, pentads and hexads. Then there are two divisions made in each chapter, classifying these elementary bodies into non-metals and metals; by this method the whole subject is made very clear. Then comes a long chapter, VIII, on the compounds of these chemical elements, the whole being given in as concise a form as is possible, taking into consideration the small space available. The making of the compound is described, and a list is appended giving almost all the well-known compounds of the substance under review with other bodies. For example, Hydrochloric acid is given on page 51, then the salts that are obtained from this acid combining with other metals and bases, and their name—chloride—is also given together with a copious list of these compounds with their chemical formulæ. In a much similar way are the oxides, fluorides, bromides sulphides, sulphates, nitrites and nitrates, and many others, created.

The work was compiled from the notes taken by the author, while attending Dr. Frankland's lectures in the Royal School of Mines, which were expanded afterwards. This will explain the value of the book for students similarly situated. At the bottom of the 14th page we find a foot note, which alludes to the list of elements above, and that gives an idea how this little book could be made use of by students who may be studying for the lower or the higher standard examination according to their requirements.

We are disposed to endorse the view of the late Professor Holdsworth Fisher of Hooghly College that the book is a good one—containing much that is useful, presented in an instructive form.

General Articles.

SCHOOL OF ARTS—MADRAS.

II.

Our drawings show two details of entrances to the School of Arts. The public entrance, and the side entrance for students.

The public entrance it will be seen is composed of an outer lofty Gothic arcade 24 feet high in the centre with a cupola above. The stone ribs of the Gothic arch are however supported on stone corbels cut with Indian designs. After passing through this lofty arcade, the doorway to the public hall or museum is quite of a different character, being the usual Indian lintel with side posts, but with a Gothic stone rose or wheel window above.

The side entrance for pupils is also entirely of an Indian pattern. The stone pilasters have Indian capitals. The stone lintel and side posts are Indian, and even the door is entirely like those seen in Hindoo houses. Yet immediately above this is a fan light of coloured glass, a material only lately introduced into this country.

This combination of the Gothic or European, with whatever is beautiful in Indian architecture, is not unpleasing as may be judged from these drawings. When our crusading forefathers brought the pointed arch from the East into Europe, they also at first used it only as a pleasing ornament, but when its constructive advantage became known, it caused a revolution in the European architecture of that period, and was the origin of what is now known as the Gothic style. Into this revolution all the improvements of the previous systems were introduced. For instance, the large arched windows of our Gothic Munsters, divided by stone bars on mullions into smaller arcades, are only a repetition of the grouped windows of the previous Romanesque epoch. Thus the improvements in the Gothic and classic styles of architecture acted and reacted on each other to the mutual advantage of both. What Europe has lost by its ignorance of Indian architecture at that time who can now imagine. Had it formed a triplet in this chain of improvements we may have now reached that happy state of perfection to which all architects and artists are aspiring. An ancient architecture, that passed through thousands of years of development, by people of a specially acute and active mind, must have in it something worthy of imitation and adoption. The Hindoos were compensated by nature for a weak physique, by a strong restless mind, which delighted in massing ornament over ornament, and elaborating designs with the greatest minutiæ. The nearest approach to this in Europe is what is called the "Flamboyant" style in France in the 15th century.

It is only within the last few years that European light and learning has been drawn to Hindoo architecture. The exertions of the Archæological Department in publishing, and explaining Indian forms of design and construction is opening the flood gates to Europe, which will probably cause a greater revolution in the architecture of the world than the introduction of the pointed arch by our crusading fathers into Europe.

Mr. Chisolm's quick intelligence seized and mastered the beauties of Indian work, and he introduced them freely into his designs. Any architect or builder, however high his European attainments, to be useful in this country, will also have to make this his first study, as there are some forms that are specially adapted to this country, as for instance the projecting overhanging cornice, that gives shade without obstructing ventilation. If the architecture of a country records its true history, not in perishing books but in undying stone, then who will say that Mr. Chisolm has not written a true page of present Anglo-Indian History, in combining Indian and English forms in the stones of his buildings? In this year of loyal jubilation, do we not all wish that this combination may be more complete, and result in increased strength, beauty, and usefulness to all. We will conclude this portion of our article by quoting what Bishop Heber, who travelled through a great deal of Europe, says about our Indian buildings:—"I had heard much of the airy and gaudy style of oriental architecture; a notion I apprehend taken from that of China only; since solidity, solemnity, and a richness of ornament so well managed as not to interfere with solemnity, are the characteristics of all ancient buildings I have met with in this country. I recollect no corresponding part of Windsor at all equal to the entrance of the castle of Delhi and its marble hall of audience; and even Delhi falls very far short of Agra in situation, in majesty of outline, in size, and the costliness and beauty of its apartments. They are not the Mussalmans only who have surprised me. At Benares indeed the Hindoo works are all small; but in the wild countries which I am now traversing, and where the Hindoos have been left very much to themselves, there are two palaces, Umeer and Jyepoor surpassing all which I have seen of the Kremlin, or heard of the Alhambra; a third, Joudpoor, which I have not seen, is said to be equal to either; and the Jain temples of Aboo, on the verge of the Western desert, are said to rank above them all. The Patans built like giants and finished their work like jewellers."

In our next we will give details of another interesting portion of these buildings.

J. H. S.

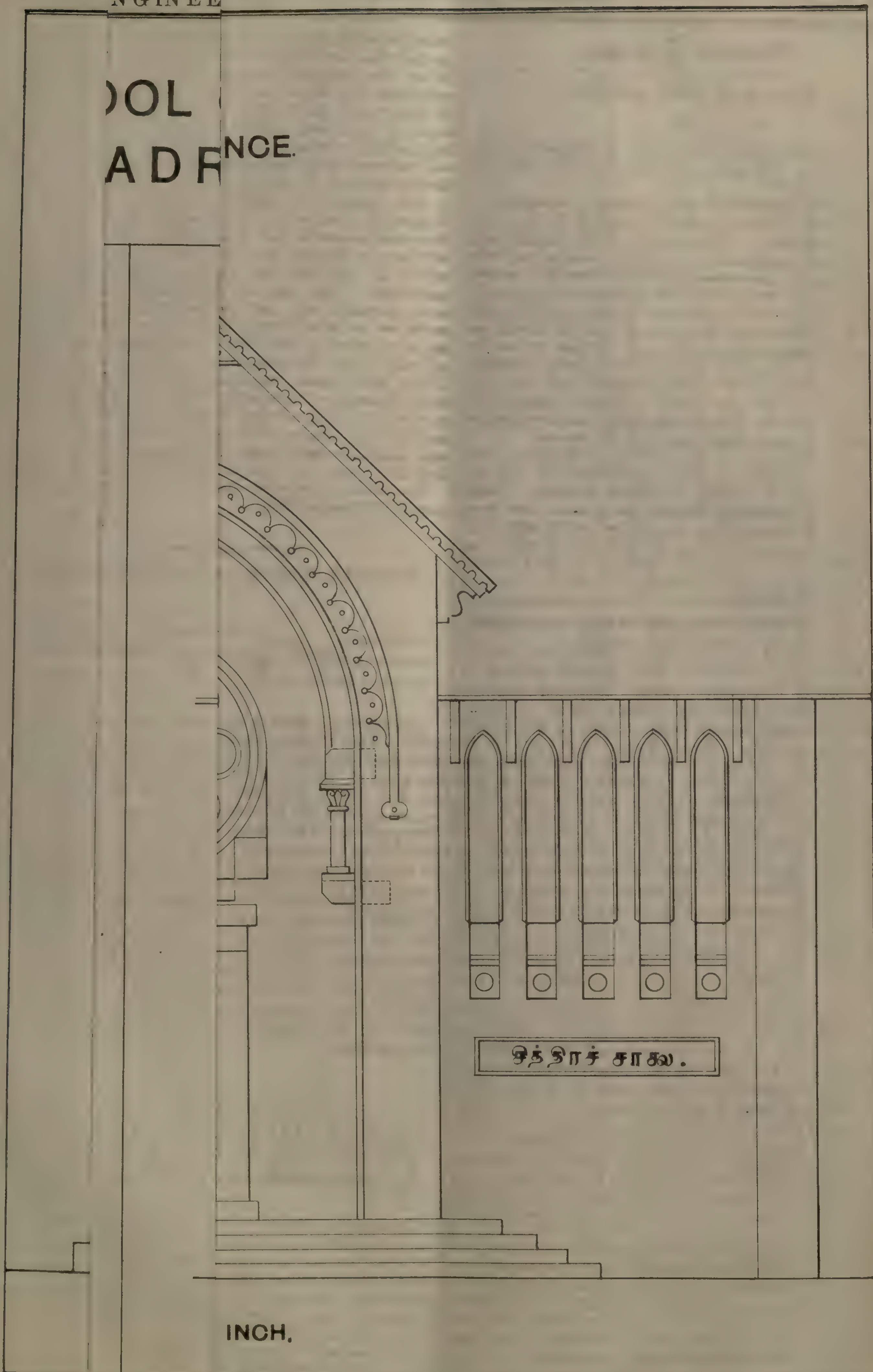
HOOGHLY BRIDGE CANTILEVER GIRDER.

An interesting question has arisen in connection with the testing of the Hooghly Bridge Cantilever Girder. It has been discovered that when one shore span only is loaded, the point of junction of the cantilever and shore girders on that side is depressed, and that the same point on the opposite side is elevated to a corresponding extent. The question is what shape does the lower boom assume under these circumstances? It is evident that it cannot be a straight line, because if that were the case the holding down bolts at the two piers would be seriously damaged in a short time by the alternate wrenching caused by trains travelling up and down the line; and as this has not occurred, it may be assumed that they are strong enough to hold the centre part of the girder, (between the two piers) in its normal position—at any rate so far as the lower boom is concerned. This being the case the lower boom probably assumes a curve of the nature shown in the sketch and this curve should approximate to a parabola.

It would be interesting to know whether the bow is capable of taking up all the deformation thus caused, or whether the bars a, b, c, are buckled when the train is loaded on the A span only. It is very easy to test this by stretching a fine silk line along the bars a, b, c, and then noting the result on loading the shore span, and we hope the experiment will be carried out during the testing operations, which are in the charge of Major Sedgwick, R. E., Deputy Consulting Engineer. The effect on the bar d, also should be carefully noticed.

C. E.

NGINEE



The "STAR" Press, 29 Lall Bazar Street, Calcutta.

THE CONSTRUCTION OF THE HONEY-CELL;

OR,

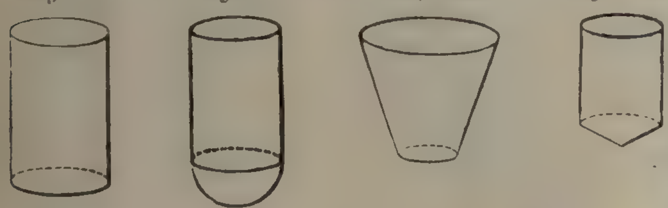
THE BEE AND HIS D. P. W.

BY A. EWBANK.

VI.

We have seen the bee give his honey cell a pointed base first for engineering reasons and secondly perhaps for material-economy reasons. We may now point out a third reason. When the ordinary schoolboy (biped) tries to clean out the remains of a jam pot with an ordinary spoon he finds a difficulty in extracting the jam from what he might call the corners, or the inside edges. A vessel with a horizontal circular or polygonal base and with vertical walls has along the base boundary what we may call a rectangular inside edge. The schoolboy would be gratified if jam pot makers would avoid such inaccessible edges or what we may call elongated corners.

Fig. 11. *Fig.* 12. *Fig.* 13. *Fig.* 14.



He would consider that such a jam pot, indicated in *fig.* 1, might with advantage be modified either by a hemispherical base as in *fig.* 12, which abolishes corners altogether, or by having the pot with sloping sides, as in *fig.* 13, which *opens* out the corners or inside edges making them obtuse instead of rectangular. Still another plan is indicated in *fig.* 14 where by opening out the boundary corners we introduce another corner in the centre of the base. But this new corner is accessible to the schoolboy's spoon or to his still more insinuating finger. Now this last diagram reminds us of the bee cell and in each we see that the sloping base has improved the vessel in what we will call the quality of accessibility.

The housewife agrees with her son Tommy that jam pots should be thoroughly cleaned out. Otherwise the new supply of preserve might contract some germs of disease from the remnants of the former supply. The housewife has steam or hot water at her service to search out the most retiring corners. But the bees have no supply of hot water laid on, and, if they had, they could not introduce it into vessels made of wax. They must therefore lick out the old honey as best they can and it is of some importance to them to have the corners quite accessible. If the bee for any other reason had been disposed to make the cell base still more pointed he would have introduced at the vertex P′ a less accessible corner. If, on the other hand, he had stopped his base-sloping process at an earlier stage then the edges made between the pyramidal faces and the vertical walls would have been less accessible than they are at present. We see therefore that he has so adjusted matters as to give each edge the *same* amount (120°) of openness.

Now I think that this quality of accessibility would seem more important to the thoughtful bee than the question how much wax it would take to build a cell; and that after engineering considerations had made him point his base he would follow out and increase the pointing process chiefly because it was seen to improve the corners. When he had reached a symmetrical stage and saw all the edges looking alike he would have the plan stereotyped. As a matter of fact there was also the economy of material. Since both advantages belong to the same shape the bee was not called upon to sacrifice that advantage which he might think the less important. But the openness of the corners is more likely to have impressed his mind than the consideration of the wax he had used. For the corners so to say stare him in the face, while the amount of wax he had expended could only be ascertained by referring to the Stores Department and it is not clear that in those early days exact records were kept of the amount of material disbursed.

However the old idea (among bipeds) that the bee was influenced solely or chiefly by the thought of saving his wax gave occasion once to a curious incident. For P an experimenter carefully measured one of the angles of the bee-cell. He then desired Q, a mathematician, to calculate what this angle ought to be to give the least expenditure in wax. Q's answer though nearly the same as P's was not exactly the same. But P was so satisfied of the exactness of his measures and so confident also that the bees were past masters in wax economies that he begged Q to repeat his calculations. Thereupon Q brought out an answer exactly agreeing with P. Then Q naturally asked himself what mistake he had made at the first. He found that he had himself made no mistake, but in determining the number of degrees in the angle he had used a certain edition of a book of logarithms. Now in this edition there was a misprint and this misprint had given Q his wrong numerical result. A Captain of a ship uses a book of logarithms to determine his place at sea. A mistake in a figure will give him his position wrong and may cause the loss of his vessel. That the measurement of an angle in a tiny bee-cell should conduce to saving the life of a ship and its crew is a curious illustration of what we may call solidarity in things human.

Here we may end this study of the bees and their D. P. W. Perhaps some specialist in geometrical drawing will give us a careful delineation of a honeycomb showing the grouping of the cells and their orientations as found in nature. Although I have incidentally studied all modes of mathematical drawing, yet from want of practice I have not the power to work with accuracy *and* rapidity.

There are other insects besides bees that show judgment in "construction." There are birds also who have to practise extreme ingenuity to make their family circles inaccessible to undesired visitors. And among four-footed creatures there is the beaver. Sympathetic studies by competent naturalists of the history of construction in these various communities would I think be highly esteemed by the readers of this journal. The parallelogram of forces or the principle of the lever is not a question of size. In the Menai Bridge or in the home of the ants the mechanics may be the same.

Animals like men have reasoning powers—the difference is a difference of degree. We are all of us—insects or men—like children standing on the seashore or venturing a little way into the waves. Some of us are stopped where the water is six inches deep—others can go out much further. But the water everywhere into which we venture is in quality just the same.

"He prayeth best who loveth best
"All things both great and small,
"For the dear God who loveth us
"He made and loveth all."

ERRATA:

In *fig.* 7, p. 217, the dotted line E_1E should not be produced below E.

In *fig.* 7, p. 200, the direction of P′P is not accurately drawn.

P. 151, right hand column, 3rd paragraph, for "*as* nearly round" read "or nearly round."

P. 167, for "omit *for* consideration" read "omit from consideration."

P. 184, for "$2b+x > \sqrt{b+x}$" read "$2b+x > 2\sqrt{b+x}$."

P. 185, for "*dovetail* vessel S E H R T" read "dovetailed vessel S E H R T."

P. 185, left column, for "they accept the *ideas*" read "they accept the idea."

P. 200, right hand column, last line, for "*dovetails*" read "dovetail."

P. 201, left column, for "shifting *re* raising" read "shifting, *i.e.*, raising."

P. 201, right hand column, for "*as* for ventilation" read "or for ventilation."

P. 201, right hand column, 4th paragraph, for "known to be hexagon" read "known to be a hexagon."

P. 201, right hand column, 5th paragraph, for "they had as *we* think" read "they had as I think."

Same paragraph, for "humans *as* other unscrupulous" read "humans or other unscrupulous."

P. 217, right hand column, line 8 from bottom, for "*in* the same" read "on the same."

P. 218, right hand column, line 12 from top, for "F P C C, of *fig.* 7" read "F P C C_1 of *fig.* 7."

P. 217, left column, for "axial lengths" "read axial length."

JODHPORE PUBLIC OFFICES.

Specification.

Foundation has been taken at an average depth of 8 feet below ground on a bed of concrete 2 feet thick extra.

Foundation plinth and superstructure to be of coarsed rubble masonry.

Interior arches relieving arch over openings and domes to be of slabstone and mortar.

Cutstone work coping the plinth, all verandah arches, all pillars including caps, bases, shafts and upper portions above caps. Brackets, chujjah, lintels, string courses, steps, balustrades and tracery in verandah arches.

Floors everywhere on ground floor slabstone paving; on upper story terraced.

Tracery work in Roof chunam pierced.

Doors and windows of well seasoned teak.

Pucca Plaster all the interior.

Painting all the exterior.

Roofing of slabs terraced.

Domes of slabstone, plastered and polished with white lime.

Covering over projecting brackets to be of slabstone.

Shelves to be of slabstone.

Hooks to be provided for punkhas, &c., in every room and in all walls at suitable height, for wall lamps, notices, &c.

Parapet wall above roof estimated to be in ornamental plaster, if funds hereafter permit should be in cutstone.

Work to be everywhere in accordance with the standard specification in force at Jodhpore.

General Abstract of the probable cost.

Block A.	... ...	1,40,502
Do. B. North and South	... ...	74,250
Do. C.	... ...	67,022
Do. D.	.. .. ..	67,022
Total Rs.	...	3,48,796

Abstract, *A*.

Quantity.	Items.	Rate.	Per.	Amount.
		Rs. A. P.		Rs.
164,143 c. ft.	Excavation for foundation...	3 0 0	‰	492
33,690 ,,	Concrete Work ...	15 0 0	%	5,053
97,944 ,,	Foundation and Plinth Masonry	15 0 0	,,	14,692
127,404 ,,	Superstructure... ...	20 0 0	,,	25,480
2,130 ,,	Katta archwork for Dome	50 0 0	,,	1,065
13,100 ,,	Do. archwork ...	30 0 0	,,	3,930
9,836 ,,	Cutstone do. ...	50 0 0	,,	4,918
7,000 ,,	Do. Pillars ...	2 8 0	c. ft.	17,500
2,008 s. ft.	Do. Talees ...	3 0 0	s. ft.	6,024
4,180 c. ft.	Lintels	40 0 0	%	1,672
4,022 s. ft.	Cutstone Dassa ...	0 8 0	s. ft.	2,011
2,131 r. ft.	Do. String course ...	40 0 0	%	852
1,184 No.	Do. Brackets ...	5 0 0	each.	5,920
10,808 s. ft.	Do. Chujja ...	0 6 0	s. ft.	4,053
31,769 ,,	Slab Roofing	25 0 0	%	7,942
478 ,,	Steps	0 8 0	s. ft.	239
1,335 ,,	White lime polish over Brackets	15 0 0	%	200
3,424 ,,	Covering for Balustrade ..	25 0 0	,,	856
10,860 ,,	Slabstone pavement ...	15 0 0	,,	1,629
1,600 ,,	Kunker floor 2 feet thick ...	6 0 0	,,	[illegible]
5,008 ,,	Doors and windows of Teak Wood	3 0 0	s. ft.	15,024
2,080 ,,	Katehra (Balustrade) ..	1 8 0	,,	3,120
7,598 r. ft.	Cutstone cornice 12″ × 12″ ...	50 0 0	%	3,799
134,459 s. ft.	Pca. Plaster	4 0 0	,,	5,378
23,356 ,,	Pca. Painting ...	3 0 0	,,	701
13 No.	Fire places	30 0 0	each.	390
80 No.	Shelf Stones	1 8 0	,,	120
	Hooks for Purdas ceiling and Punkhas ..	......	...	300
2,368 s. ft.	Kungoora (or ornamental plaster)	15 0 0	%	355
	Total Rs.	......	...	1,33,811
	Contingencies ...	5 0 0	cent.	6,691
	Total Rs.	.. ...	...	1,40,502

Abstract, *B*.

Quantity.	Items.	Rate.	Per.	Amount.
		Rs. A. P.		Rs.
68,065 c. f.	Excavation for foundation	3 0 0	‰	204
14,690 ,,	Concrete Work ...	15 0 0	%	2,194
29,543 ,,	Foundation and Plinth Masonry ...	15 0 0	%	4,431
25,152 ,,	Superstructure ...	20 0 0	%	5,030
1,726 ,,	Cutstone Pillars ...	2 8 0	c. ft.	4,315
3,030 ,,	Do. Arches ...	50 0 0	%	1,515
2,092 ,,	Katta Archwork ...	30 0 0	%	628
1,465 s. ft.	Cutstone Dassa ...	0 8 0	s. ft.	732
1,568 ,,	Teak wood doors and windows ...	3 0 0	,,	4,704
3,910 ,,	Cutstone Chujja 4ft. projecting ...	0 6 0	,,	1,466
436 No.	Cutstone Brackets $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{3}$	5 0 0	each	2,180
937 r. ft.	Do. String course ...	40 0 0	%	375
8,598 s. ft.	Slab Roofing ...	25 0 0	%	2,125
3,719 ,,	Slab Stone Pavement ...	15 0 0	%	558
788 ,,	Katehra (Balustrade) ...	1 8 0	s. ft.	1,182
1,837 r. ft.	Cutstone Cornice ...	50 0 0	%	918
645 s. ft.	Do. Steps ...	0 8 0	s. ft.	323
27,738 ,,	Plaster interior ...	4 0 0	%	1,110
9,104 ,,	Pca. Painting ...	3 0 0	%	273
72 No.	Shelf Stone .	1 8 0	each	108
572 c. ft.	Katta Archwork for Dome	50 0 0	%	286
3,200 ,,	Kunker 2ft thick ...	6 0 0	%	192
	Hooks for Purdas & Punkhas	...	...	300
5 No.	Fire places ...	30 0 0	...	150
390 s. ft.	Ornamental Plaster ...	15 0 0	%	58
				35,357
	Contingencies . .	5 0 0	cent	1,767
	Total for ½ B ...	......	...	37,125
	∴ B = Total Rs. ...	......	...	74,250

Abstract, *C & D*.

Quantity.	Items.	Rate.	Per.	Amount.
		Rs. A. P.		Rs.
151,042 c. ft.	Excavation for foundation	3 0 0	‰	453
33,418 ,,	Concrete work for Do. ...	15 0 0	%	5,013
84,811 ,,	Foundation and Plinth Masonry ...	15 0 0	%	12,722
35,376 ,,	Superstructure ...	20 0 0	%	7,075
4,744 ,,	Katta Archwork ...	30 0 0	%	1,423
3,566 ,,	Cutstone Arches ..	50 0 0	%	1,783
3,077 ,,	Do. Pillars ...	2 8 0	c. ft.	7,692
1,994 s. ft.	Do. Dassa 6″ thick ...	0 8 0	s. ft.	997
2,472 ,,	Teakwood doors and windows ...	3 0 0	,,	7,416
62 No.	Cutstone Brackets 3′ × 3′ × 4″	10 0 0	each	620
512 ,,	Do. $1\frac{1}{2} \times 1\frac{1}{2} \times 3''$	5 0 0	,,	2,560
1,270 s. ft.	Cutstone Katehra ...	1 8 0	s. ft.	1,905
4,840 ,,	Do. Chujja 4′ projecting	0 6 0	,,	1,815
1,364 ,,	Ornamental plaster to parapet ...	15 0 0	%	205
13,999 ,,	Slab Roofing ...	25 0 0	%	3,500
10,565 ,,	Slab Stone Pavement ...	15 0 0	%	1,585
2,858 ,,	Cutstone Steps ...	0 8 0	s. ft.	1,429
3,184 r. ft.	Do. Cornice 12″ × 12″...	50 0 0	%	1,592
585 c. ft.	Katta archwork for Dome...	50 0 0	%	292
47,283 s. ft.	Plaster interior ...	4 0 0	%	1,891
10,105 ,,	Pca. Painting Exterior ...	3 0 0	%	303
8 No.	Boorjees 4 ft. high ...	40 0 0	each	320
10 ,,	Fire Places ...	30 0 0	,,	300
293 ,,	Shelf Stones ...	1 8 0	,,	440
	Hooks for Purdas ...	...	...	500
				63,830
	Contingencies ...	5 0 0	cent.	3,191
	∴ for 2 similar Blocks ...	...	...	67,022
	Total Rs. ...	...	...	1,34,044

S. S. JACOB, Lt.-Col.

EDUCATION.

THERE was once an old Greek who used to exasperate his respectable fellow citizens by requiring them to put precise definitions on words of common acceptation. In modern days when the word 'education' is used we picture to ourselves large classes of students absorbing knowledge from books. But in this process there may be plenty of education, or there may be next to nothing.

Let us take a boy of three years of age. Let him be taught to run, to leap, to skate, to row, to swim and to ride. In all these and in other athletic amusements, such as cricket and football, let him become an expert.

Let his sight be cultivated by identifying distant animals by their forms or movements. Let his hearing be cultivated by identifying sounds made intentionally faint. Let his touch be cultivated by learning to distinguish in the dark between various objects which are almost, though not quite, identical. Let him be encouraged to study and vividly remember form by making drawings if he shows a predisposition in that direction. Let him have no knowledge of books, and so acquire all his knowledge by conversation or observation.

In all his amusements some knowledge has been acquired. But this knowledge has been acquired incidentally. The direct object aimed at was the development of his physical powers and of such mental qualities as courage, presence of mind, perseverance, and rapidity of decision. Now, this is education. The education, indeed, is by no means complete. It will not admit him into the Civil Service or even into a Regiment of the Line. But yet this education, as far as it goes, is both genuine and excellent.

As another case let a boy be early taught to read and let him spend all his available time learning several modern languages, so as to write or speak them, but not to be influenced by their literatures. Let the mode of study be such that acquisition of the languages was made the main object and not any particular mental training. It would not be correct to say that this latter boy was better educated than the former, or even so well educated. Many Englishmen now living spent long years at school but, while they were school boys, obtained the greater and better part of their education outside the school walls.

When a parent desires education for his son he usually contemplates the acquisition of such knowledge as is directly tested in the various competitive or qualifying examinations. Similarly, when a statesman desires to construct a scheme of national education he usually deals only with such mental acquirement or such skill of hand, as is directly needed for industrial pursuits.

But when a wise parent or a capable statesman makes a thorough study of the subject, he sees that we have to educate—that is—cultivate and develop—all the bodily faculties. We have to educate, that is, call out and strengthen all the intellectual faculties. We have to educate—that is, discipline and refine—all the emotional faculties. This only is true education. But we have besides to store the mind with various facts so arranged as readily to suggest themselves for social and professional requirements. The more completely we can blend the cultivation of the whole human nature with the mere absorption of knowledge, the more scientific—that is, thorough and successful—is our scheme of education

At this point of the discussion our constant friend, the unscientific politician, may be expected to step forward and blandly to explain that this scheme is so perfect as to be impossible of accomplishment. Precisely so. It is also equally impossible to draw a true circle. Nevertheless, the draughtsman has not failed to understand that it behoves him perfectly to know what *is* a true circle. A wise statesman, knowing how imperfect his scheme must be, will be ready and watchful to welcome, foster and direct all subsidiary beneficial agencies, whether these emanate from municipal bodies and corporations or from private liberality.

The first duty of every State is to preserve order. Its *next* duty is to educate its citizens. The magnitude of the work is such that it cannot be performed *by* the State. The interests at stake are so great that they cannot be promoted *without* the State. In other words, the Government and the people must both put their shoulder to the wheel.

What parts of the work should be specially conducted by the State and what parts by corporate or individual enterprise will depend on the general conditions of the country. In India, and at the present time, the most elementary education and also the most advanced should be specially cared for by the State. In all countries and at all times the instruction of the very poorest classes should be a chief function of the Government. No expense can be too great for educational objects if only the education is good and reaches the best latent talent.

Language—as this journal has lately reminded us—is fossil poetry. Education is not as putting something in, but as bringing or leading something out. Instruction is allied to *con*struction and reminds us that—not the amount of knowledge shovelled into the mind but—the way this knowledge is *built* up within the mind is the thing chiefly important. Lastly, information does not imply a simple swallowing of facts. It asks us the question how the mind is *formed inwardly* by reason of the knowledge it has stored.

RAILWAYS IN BURMA.

(*Expressly for* INDIAN ENGINEERING.)

Lower Burma.—The total outlay of capital on State railways during the past year is given as follows:—On the Irrawaddy line, a distance of 161 miles, Rs. 2,32,560, and on the Sittang line, a distance of 166 miles, Rs. 14,15,690; the excessive expenditure on the latter line is owing to rolling stock purchased and buildings and stations constructed. No large improvements were made on the Irrawaddy line more than replacing 16 wooden bridges for wrought-iron structures, and building a military siding at Prome for the expeditionary forces to and from Upper Burma. Progress in the direction of extending the railway was intended, and with this view estimates were submitted for a proposed line from Henzada to Bassein, but the funds originally sanctioned for this purpose were availed of for other urgent needs.

The capital outlay from the commencement of railway operations to the end of last year is given as:—On the Irrawaddy line Rs. 1,40,50,460; on the Sittang line Rs. 1,32,34,880. The capital of both lines was amalgamated on the 1st January last, and a suspense balance now remains of Rs. 7,53,250, which represents value of locomotives and general stores. The net earnings of both lines for the past year was Rs. 21,63,650, and it is expected that as soon as order is restored in the Shan States the traffic on the Sittang line will be largely increased.

Upper Burma.—The most important works now being undertaken is the Toungoo and Mandalay Railway. Some years back, when the line was completed up to Prome, it was proposed to extend the line across the Irrawaddy to Allanmyo, and at a future period to carry it on to Mandalay; but since more of the country has been learnt beyond Toungoo, and it was ascertained that the range of hills known as the Pegu Yoma sinks almost to nothing about Yamethin, and the distance from Toungoo to Mandalay being 60 miles less than from Prome, it was decided by the leading authorities to take the Toungoo route. Indeed, commercially speaking, it is the best step, as the trade centres along the Irrawaddy are well served by steamers and boats, whereas the tract of country from Ningyan to Kyaukse and thence to Mandalay is absolutely without any means of communication whatever, and Mr. Mathews' selection was no doubt a wise one, as it is far better to carry a railway line through a land locked tract without communications than carry it alongside a navigable river. The Toungoo route also serves the passes and caravan routes into the Shan States, whereas the Irrawaddy line would be some 100 miles away. It has also been found during the survey operations that the Toungoo route touches countries possessing large coal sources, and a gentleman of the Geological Survey has been deputed to report on the coal resources of Hlaingdet and the bed of the river Panlaung near the proposed railway alignment. Indeed, it has been reported to the civil authorities by old residents, that large supplies of coal were regularly carted from it in old King Mindon Min's time.

The line from Toungoo to Ningyan, a distance of 59 miles, is being pushed on vigorously. Ningyan is one of the principal centres of the timber trade. The levels taken show a rise of 140 feet between Toungoo and Ningyan. The only large stream is the Swa, which will require a waterway of 350 feet with two openings of 100 feet. Beyond Ningyan the line passes through the valley at places barely 15 miles broad between the Shan Hills on the east and the Pegu Yoma range on the west. This valley leads straight on to Yamethin, which is the principal town and trade mart between Ningyan and towns on the Irrawaddy. Yamethin lies at the water parting,

(the spill from a canal on the north of the Yamethin rampart flows into the Irrawaddy *viâ* three large streams named the Samon, Paulaung and the Myitnge, while the spill from a large tank under the south rampart makes its way into the Sittang *viâ* the Sinthe river,) and it is the highest point on the Mandalay line. According to barometrical readings it is about 300 feet above rail level at Ningyan, and 450 feet above Toungoo. The section from Ningyan to Yamethin is about 55 miles in length; it crosses two large streams, the Ngaleik and the Sinthe, which will require about 500 to 1,000 feet of waterway. The line has been surveyed and partly constructed. To the north of Yamethin the line takes a straight course to Kyaukse. The line, as surveyed, shows the route would go by Pyabwe, Nyaungyan, Wundwin and thence to a point on the Panlaung river near Myittha, whence it would run straight into Kyaukse. From the survey taken it would appear that no high ground has been encountered. The section from Yamethin to Panlaung is 55 miles; it will have to cross the Samon river probably twice. It is supposed that the Panlaung Bridge will not be a difficult task. The section from Panlaung to Mandalay is about 50 miles. The site for the bridge over the Myitnge has been selected.

The sections of the Toungoo-Mandalay Railway as proposed stand as follows :—

	Miles.
Toungoo to Ningyan (operations commenced) ...	59
Ningyan to Yamethin (do. partly commenced) ...	55
Yamethin to Panlaung river (only surveyed) ...	70
Panlaung to Mandalay (operations commenced) ...	50
Add for deflections ...	6
Total miles ...	240

The cost of the line is estimated at 183 lakhs of rupees. Sanction for its construction was received in November and work was at once undertaken at Toungoo and later at Mandalay. It is expected that the rails will be laid from Toungoo to Ningyan about end of July, and the lines from Mandalay to Panlaung about the end of the year. Railway stock is fast coming in.

C. H.

THE MADRAS HARBOUR.

Its Construction, Destruction and Reconstruction.

VII.

Thus far we have dealt with the first period of the history of the Madras Harbour, and more space than was intended having been occupied with that period, our consideration of the remaining two periods must be briefer than their importance demands. No one concerned, not even Mr. Parkes himself, seems to have been confident that the piers of the harbour would stand the test of a cyclone. The report of Mr. Parkes, from which we quoted towards the close of the last article, was written in response to a request from the Madras Government that he would comment on a memorandum by the Master Attendant and the Chief Engineer of Madras on the harbour works then in course of construction at Colombo from the designs of Sir John Coode. These officers, while on a tour which seemed to have embraced an examination of the Pámban (or Paumben) channel, were authorised to visit the works at Colombo, and two things chiefly struck them, *first*, the much greater mass of the superstructure of the breakwater there and the careful bonding of the works as compared with that of the Madras piers, and, *second*, that it was considered " necessary to further protect the sea face of the work after completion by tipping in masses of *pierre perdue*, the greater part of the stone so used (very hard granite) being of large size, the intention being apparently to establish all along the face an outer rough stone revetment which, when settled down, shall rise to about 12 feet below M. S. L." The Madras officers admitted that the two cases were not altogether comparable, but they thought it would not be out of place, now that the Madras work had been advanced so far towards completion, (without, however, during its construction having had to sustain the shock of any very heavy gale or cyclone sea) to ask the projector, Mr. Parkes, to explain his own views as to the difference in section of the two works. " It would no doubt be satisfactory to Government and the public," they said, " if he were distinctly to affirm his opinion that the different circumstances of the Madras work are such as to enable him to pronounce definitely his conviction as to its stability, not only in regard to the shocks to be sustained by the sea in a maximum cyclone, but also in cases of a heavy ship being at such time driven against the breakwaters as now constructed," and they wanted to know whether some roughstone protection on the sea face such as was then given to the Colombo work, might not be wanted at Madras particularly for the northern arm of the Harbour. In his reply, dated 4th August 1881, Mr. Parkes abstained " as far as possible from any comparison of the conditions to be met at Colombo and Madras, or of the mode in which the Engineers of the two works have, in the independent exercise of their judgment, endeavoured to meet them." He would simply address himself to the very legitimate questions raised by the Madras officers, and in regard to the *first*, he said he was not disposed, even after his successful experience of ten years at Karachi and five at Madras, to accept the invitation " to pronounce definitely his conviction " on the subject. " When the long-threatened cyclone visits Madras, it will no doubt," he said, " teach us a lesson," on the nature of which he would not speculate. All he felt justified in then saying was that he did not think the breakwaters would be strengthened by adding to their width, nor could he then suggest any other way in which they could be made more secure. With regard to the *second* question raised by the Madras officers, Mr. Parkes thought that the features of his design for the superstructure made him quite independent of the use of large roughstones as a protection for it on the sea face. The " deep foundations " might be viewed as a substitute for them. But in shallow water he had used a foreshore of large concrete blocks, and he further intended, as an extra precaution, to place some blocks at the feet of the pier head walls.

Colonel Sankey, the Chief Engineer of Madras, on commenting on this opinion of Mr. Parkes', while admitting that the height of the sea at Madras might not be so great as at Wick or in many other parts of the world, and admitting also the validity of the unbonded system of construction, said that neither of these contentions by Mr. Parkes met the question raised, namely, why the width of the piers at Madras should be 10 feet less than at Colombo, and he said that the arguments adduced in support of the narrower section were not strengthened by the expression of Mr. Parkes' opinion that he sees " no reason for thinking that the breakwaters would be strengthened by adding to their width," and, again, Colonel Sankey said—with reference to the second of the questions that had been raised—that it would have been more satisfactory had the reasons assigned by Mr. Parkes for his opinion that no protection of rough-stone was necessary, borne completely on the facts of the case, and particularly in reference to the comparatively soft quality of the material used for the rubble base, " should Mr. Parkes be perfectly satisfied that, notwithstanding all appearences to the contrary, the conditions" (of stability) " have been fulfilled, there is really nothing more to be said on the question. If Mr. Parkes prove right on this point he may justly claim to have executed a work on bolder principles than elsewhere ; and as his work, judged by the length of the piers, will not have cost one-half of that of Colombo, foot by foot of length, he will have every reason to be proud of the achievement and to claim as a distinct merit the comparative economy of his great work." Colonel Sankey's scepticism is here very thinly veiled, and even a vein of irony seems to run through his remarks, though Mr. Parkes, in August 1881, as we have seen, declined the invitation to pronounce definitely his conviction of the stability of his work, he had not always been so cautious, for, as the local newspapers brought to remembrance when the catastrophe occurred, he had in the month of March previous, in a lecture publicly delivered, said he

TYPICA

DIAGRAM No. 4

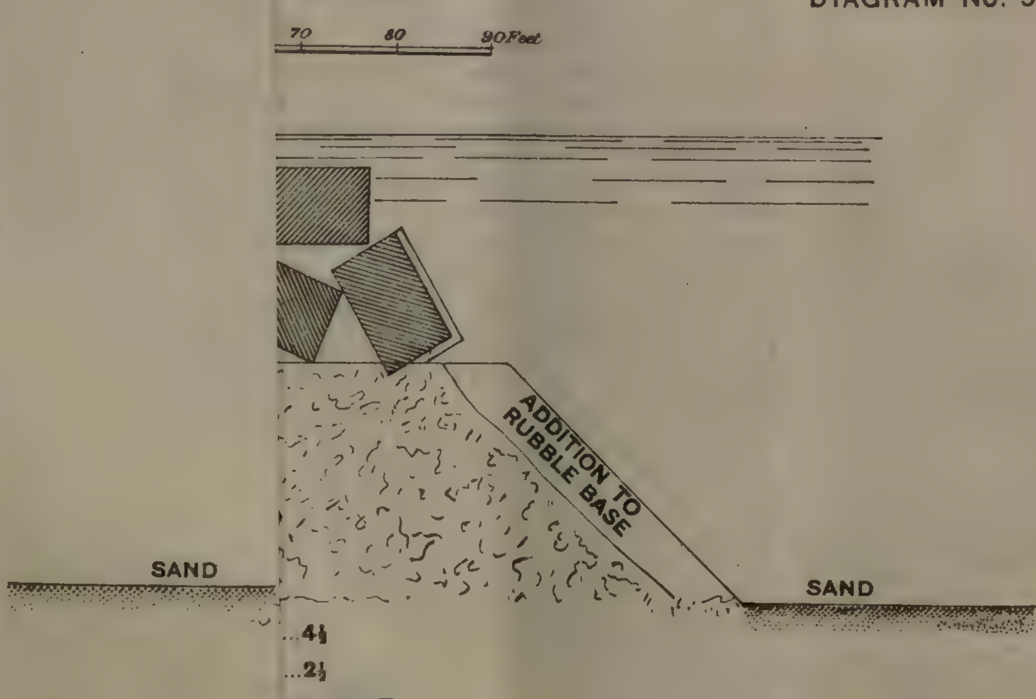
TYPICAL SECTIONS OF ELBOW.

o. 3.

2400

ICTION.

DIAGRAM No. 5.



...4½

...2½

4½ FEET

AL OF PIER

ft. Lineal.

The "Star" Press, 10 Lall Bazar Street, Calcutta.

could afford to "laugh at Neptune. He cannot touch our sandy bottom, because it is far below his limit of 24 feet. He cannot touch our rubble stone, because it is far below his limit of 12 feet, and hitherto he has not been able to disturb our blocks at the surface, because they are too heavy for any force he has as yet been able to bring against them."

Colonel Sankey's forebodings were written on the 11th October 1881; on the 7th November the harbour works were inspected by the Governor of Madras and staff, with the Chief Engineer of the Public Works Department and other high officials in attendance. At this date the work had been practically completed in accordance with the designs, and within the estimated cost. "Everything then appeared satisfactory and secure, and the completion of the pier heads and moorings early in 1882 was looked forward to as being the only details remaining to be carried out to make the harbour an accomplished fact. It must, however, be remarked that at this inspection by the Governor and staff very confident opinions were expressed that a first-class cyclone would do serious damage." The Superintendent's summary of estimated expenditure up to that date is—

Items of Work.	Estimate.	Expenditure to Novr. 1881.
	Rs.	Rs.
Plant and Preliminaries	9,45,771	9,40,281
Rubble Base, North Pier	9,79,820	9,58,869
,, South Pier	8,89,820	8,93,245
Concrete Blocks, making	18,73,397	18,78,076
,, setting	3,99,939	3,97,172
Light-houses	20,000	. ...
Establishment	3,57,612	3,51,004
Contingencies, including Protective Works and Intercepting Sewer ...	1,78,806	2,33,822
Moorings	2,00,000	1,53,945
Total ...	58,45,165	58,06,414

and he justly said that had the work stood, it would have been "a very example of estimating for a marine work of a very peculiar description."

On the night of the 11th November 1881 began the storm that wrecked the harbour works, and during the next day the elbows and returning arms of the piers were simply knocked to pieces. Foundation and superstructure alike failed, and the moveable plant that was not on shore consisting of expensive "Titan" cranes and steam hopper barges was lost in the sea. All accounts agree that at no time was the wind violent, but the sea, though generally considered not to have been unusually high, was high enough to be a good test of the strength of the works. Mr. Parkes' piles of 27 tons blocks were knocked about as if they had been mere children's toys. In the official report of the storm, by the Government Astronomer, it is stated that the cyclone "appears to have exhausted its greatest force while crossing the Bay before reaching the coast of Southern India, which would account for the high and destructive sea far beyond and what might have been expected from the meteorological observations accompanying its progress. The centre of the storm must have struck the coast considerably southward of Madras. The lowest reading of the barometer was 29·51 at 4 P.M. on Saturday (12th), and the strongest wind was experienced between 11 P.M. and 2 A.M. on Sunday, during which time it averaged 32 miles per hour in velocity, equivalent to a pressure of about 5¼lbs. per foot." The greatest force of the wind was when its direction was East-South-East. The direction of the crests of the waves was nearly parallel to the shore, but slightly inclining from the North of East. The general direction of the waves is determined by the soundings along the coast, and as Mr. Molesworth, whose report we shall presently refer to, says—"the waves of a dangerous character must always come in broadside as on the shore, or nearly so, whatever the position of the storm." With regard to the force of the waves, there is no actual record. Mr. Thorowgood, the Superintendent of the works, did not consider the sea to be very heavy as compared with seas in the Atlantic or the North Sea, but it was the heaviest he had seen in Madras. Mr. Chisholm, C.E., the Government Architect, considered the seas of 12th November to be much higher than those which accompanied the storm of May 1872, when the velocity of the wind was 53 miles an hour, and the force in lbs. per square foot consequently nearly three times as great as in November 1881. Other authorities, including nautical men, thought the sea was comparatively trifling. The Master Attendant said that the attack upon the works on the 12th November was a very mild one, and his Deputy had no hesitation in stating it as his "solemn conviction, from careful personal observations during both cyclones, that a much fiercer sea prevailed in the storm of May 1872." On that occasion he noted that "the sea out to 9 fathoms of water was a roaring mass of breakers; the shipping at anchor were completely enveloped in spray, the rollers breaking clean over their bows and dashing wildly up to their lower mast-heads. I now state that no such sea prevailed on the 12th November last. The sea did not break in 9 fathoms of water. Had such sea prevailed the barque *Mars* would have been inevitably lost, instead of being able to go to sea in ballast trim, under double reefed topsails, and reefed foresail." Mr. Thorowgood says that the *Mars* rode out the storm at anchor, without much discomfort, to the East-South-East of the Harbour entrance, and that the general opinion of experts was that the heaviest waves ran about 15 feet high from trough to crest. It appears that the *Mars* did not put to sea till the evening of the 12th November.

The nature of the damage done to the works was pretty fully noticed in the newspapers of the day, and it will be found most minutely described in the official reports published in the Volume of Records of the Government of India on which these articles are based. The first report was made by Mr. Thorowgood, the Superintendent of the works, on the 21st November, only nine days after the disaster, by which time only a rough estimate of the damage had been made. In February 1882 Mr. G. L. Molesworth, the Consulting Engineer to the Government of India for State Railways, and Lieutenant Stiffe, of the Indian Marine, were deputed to report, and by this time Mr. Parkes had come out from Home and examined the works, and Mr. N. St. B. Beardmore, C.E., who was acting as Superintendent during the absence of Mr. Thorowgood, had made careful cross-sections of them. In Plate III. we give some of the diagrams which accompanied Mr. Molesworth's report, (Mr. Stiffe submitted a separate report), and these show so clearly what happened that hardly any description is necessary. In some instances the superstructure seems to have been knocked to pieces by the blows of the waves, the blocks falling inside the harbour, but in others the rubble base was scoured away on the outside, and some of the blocks fell also outwards, and the scour appears to have extended even to the sandy bed of the ocean. Mr. Molesworth's diagram No. 2, showing the uninjured section of the piers in deep water, seems not quite correct, the width of the crest of the rubble base being too little, and the depth of water too great. Eight fathoms is the depth of water about the entrance of the harbour, and before reaching that depth the piers, and, of course, the rubble base, had been widened, and the crest of the rubble lowered. The cross-section given in our last article is more correct for depths up to seven fathoms.

(To be continued.)

ERRATA IN No. VI.

In para 2.—"Unbed" for "Imbed."

In para 4.—The 3rd line from end of article "sufficiently" for "insufficiently."

MR. RUSKIN ON RAILWAYS.—I trust that the opponents to the Ambleside Railway, says *Truth*, will note the views upon railroads of their chief champion, Mr. Ruskin. They are, he says, "the loathsomest form of devilry now extant, animated and deliberate earthquakes, destructive of all nice social habits or possible natural beauty, carriages of damned souls on the ridges of their own graves." With this general opinion of railroads, it is only natural that he should object to one in the Lake district.

SCANTLINGS OF TIMBER FOR FLAT ROOFS.

By Rai Bahadur Kunhya Lal, M. I. C. E.,
Late Executive Engineer, P. W. D., Lahore.

The formula for *stiffness* is $E = \frac{5\ L^3\ W}{8D\ b\ d^3}$, where E represents the co-efficient for *deflection elasticity*, W the safe distributed weight, $= 2\ w$, w being the working or safe load in lbs. in the middle; L, length; b, breadth; d, depth; and D, the deflection.

Now E = 1,800lbs. for Deodar, the chief building timber used in the Punjab, then,

$$1{,}800 = \frac{5\ L^3\ W}{8\ \frac{1}{40}\ b\ d^3}$$

$\frac{1}{40}$ being the safe deflection per foot of length of timber. The above gives

$$d^3 = \frac{5\ L^2\ W}{\frac{8 \times 1800}{40}\ b},$$

$$\text{or } d = \sqrt[3]{\frac{L^2\ W}{72b}}.$$

Then, taking w' the load *per running foot* instead of the whole distributed load,

$$d \text{ becomes} = L\sqrt[3]{\frac{w'}{72b}};$$

and taking $r = \frac{d}{b}$, $d = \sqrt[4]{\frac{w'\ r\ L^3}{72.}}$

The above is the formula prescribed for calculation of scantlings of timber for flat roofs, *vide* Punjab Government P. W. D. Circular, No. 44, dated 30th November 1877.

But, as the calculations are tedious, I have calculated the scantlings for Deodar wood, for all spans from 3 to 20 feet. Beyond 20 feet, trusses ought to be adopted, which will be treated in a separate Paper hereafter. Spacings for rafters have been taken 1 foot, and for beams, 5 feet from centre to centre, which are the usual spacings adopted in the construction of buildings.

Calculations of the Scantlings of Beams and Burgahs of Deodar Wood for Flat Roofs.

(1.) Burgahs for 3 feet span—

Interval from centre to centre ... 1 foot.

L = bearing of burgahs, b = breadth, d = depth

$r = \frac{d}{b} = 1{\cdot}5.$

Weight = 100lbs. per *foot run*.

Then, $d = \sqrt[4]{\frac{w'\ r\ L^3}{72}} = \sqrt[4]{\frac{100 \times 1{\cdot}5 \times 3^3}{72}} = 2{\cdot}73$

or 3 inches, and $b = \frac{d}{1{\cdot}5} = \frac{3}{1{\cdot}5} = 2$ inches.

Scantlings 3″ × 2″.

(2.) Burgahs for 4 feet span—

Interval from centre to centre ... 1 foot.

Weight as in foregoing case, $d = \sqrt[4]{\frac{100 \times 1{\cdot}5 \times 4^3}{72}}$

$= 3{\cdot}4$ or $3\frac{1}{2}$ inches, and $b = \frac{d}{1{\cdot}5} = \frac{3\frac{1}{2}}{1{\cdot}5} = 2{\cdot}33$

or $2\frac{1}{2}$ inches.

Scantlings $3\frac{1}{2}$″ × $2\frac{1}{2}$″.

(3.) Burgahs for 5 feet span—

Interval from centre to centre ... 1 foot.

$d = \sqrt[4]{\frac{100 \times 1{\cdot}5 \times 5^3}{72}} = 4\cdot$ or 4 inches,

and $b = \frac{d}{1{\cdot}5} = \frac{4}{1{\cdot}5} = 2{\cdot}66$ or 3 inches.

Scantlings 4″ × 3″.

(4.) Burgahs for 6 feet span—

Interval from centre to centre ... 1 foot.

$d = \sqrt[4]{\frac{100 \times 1{\cdot}5 \times 6^3}{72}} = 4{\cdot}60$ or 5 inches,

and $b = \frac{d}{1{\cdot}5} = \frac{5}{1{\cdot}5} = 3{\cdot}33$ or $3\frac{1}{2}$ inches.

Scantlings 5″ × $3\frac{1}{2}$″.

(5.) Burgahs for 7 feet span—

Interval from centre to centre ... 1 foot.

$d = \sqrt[4]{\frac{100 \times 1{\cdot}5 \times 7^3}{72}} = 5$ inches,

and $b = \frac{d}{1{\cdot}5} = \frac{5}{1{\cdot}5} = 3{\cdot}33$ or $3\frac{1}{2}$ inches.

Scantlings 5″ × $3\frac{1}{2}$″.

(6.) Burgahs for 8 feet span—

Interval from centre to centre ... 1 foot.

$d = \sqrt[4]{\frac{100 \times 1{\cdot}5 \times 8^3}{72}} = 5{\cdot}70$ or 6 inches,

and $b = \frac{d}{1{\cdot}5} = \frac{5{\cdot}70}{1{\cdot}5} = 3{\cdot}8$ inches.

Scantlings 6″ × $3\frac{3}{4}$″.

(7.) Burgahs for 9 feet span—

Interval from centre to centre ... 1 foot.

$d = \sqrt[4]{\frac{100 \times 1{\cdot}5 \times 9^3}{72}} = 6{\cdot}24$ or $6\frac{1}{2}$ inches,

and $b = \frac{d}{1{\cdot}5} = \frac{6\frac{1}{4}}{1{\cdot}5} = 4{\cdot}19$ or $4\frac{1}{2}$ inches.

Scantlings $6\frac{1}{2}$″ × 4″.

(8.) Burgahs for 10 feet span—

Interval from centre to centre ... 1 foot.

$d = \sqrt[4]{\frac{100 \times 1{\cdot}5 \times 10^3}{72}} = 6{\cdot}7$ or 7 inches,

and $b = \frac{d}{1{\cdot}5} = \frac{6{\cdot}7}{1{\cdot}5} = 4{\cdot}44.$

Scantlings 7″ × 4″.

(9.) Beams for 10 feet span—

Interval from centre to centre ... 5 feet.

Weight per s. ft. (including weight of beam) 100lbs.

L = length, d = depth and b = breath of beam, and $\frac{d}{b} = r = 2.$

Then, w', or weight per *running foot* of beam $= 5 \times 100 = 500$lbs.

$\therefore\ d = \sqrt[4]{\frac{w'\ r\ L^3}{72}} = \sqrt[4]{\frac{500 \times 2 \times 10^3}{72}} = 10{\cdot}84$ or 11 inches,

and $b = \frac{d}{2} = \frac{11}{2} = 5\frac{1}{2}$ inches.

(10.) Beams for 11 feet span—

Interval from centre to centre ... 5 feet.

Weight as in foregoing case, $d = \sqrt[4]{\frac{500 \times 2 \times 11^3}{72}}$

$= 11{\cdot}6$ or 12 inches, and $b = \frac{d}{2} = \frac{12}{2} = 6$ inches.

(11.) Beams for 12 feet span—

Interval from centre to centre ... 5 feet.

$d = \sqrt[4]{\frac{500 \times 2 \times 12^3}{72}} = 12{\cdot}40$ or $12\frac{1}{2}$ inches,

and $b = \frac{d}{2} = \frac{12\frac{1}{2}}{2} = 6\frac{1}{4}$ inches.

(12.) Beams for 13 feet span—

Interval from centre to centre ... 5 feet.

$d = \sqrt[4]{\frac{500 \times 2 \times 13^3}{72}} = 13{\cdot}16$ or 13 inches,

and $b = \frac{d}{2} = \frac{13}{2} = 6\frac{1}{2}$ inches.

(13.) Beams for 14 feet span—

Interval from centre to centre ... 5 feet.

$d = \sqrt[4]{\frac{500 \times 2 \times 14^3}{72}} = 13{\cdot}98$ or 14 inches,

and $b = \frac{d}{2} = \frac{14}{2} = 7$ inches.

(14.) Beams for 15 feet span—
Interval from centre to centre ... 5 feet.

$$d = \sqrt[4]{\frac{500 \times 2 \times 15^3}{72}} = 14{\cdot}7 \text{ or } 15 \text{ inches,}$$

$$\text{and } b = \frac{d}{2} = \frac{15}{2} = 7\tfrac{1}{2} \text{ inches.}$$

(15.) Beams for 16 feet span—
Interval from centre to centre ... 5 feet.

$$d = \sqrt[4]{\frac{500 \times 2 \times 16^3}{72}} = 15{\cdot}44 \text{ or } 16 \text{ inches,}$$

$$\text{and } b = \frac{d}{2} = \frac{15\frac{1}{2}}{2} = 7{\cdot}75 \text{ inches or } 8 \text{ inches.}$$

(16.) Beams for 17 feet span—
Interval from centre to centre ... 5 feet.

$$d = \sqrt[4]{\frac{500 \times 2 \times 17^3}{72}} = 16{\cdot}16 \text{ or } 16\tfrac{1}{4} \text{ inches}$$

$$\text{and } b = \frac{d}{2} = \frac{16}{2} = 8 \text{ inches.}$$

(17.) Beams for 18 feet span—
Interval from centre to centre ... 5 feet.

$$d = \sqrt[4]{\frac{500 \times 2 \times 18^3}{72}} = 16{\cdot}86 \text{ or } 17 \text{ inches,}$$

$$\text{and } b = \frac{d}{2} = \frac{17}{2} = 8\tfrac{1}{2} \text{ inches.}$$

(18.) Beams for 19 feet span—
Interval from centre to centre ... 5 feet.

$$d = \sqrt[4]{\frac{500 \times 2 \times 19^3}{72}} = 17{\cdot}55 \text{ or } 17\tfrac{1}{2} \text{ inches,}$$

$$\text{and } b = \frac{d}{2} \; \frac{17\frac{1}{2}}{2} = 8{\cdot}75 \text{ inches.}$$

(19.) Beams for 20 feet span—
Interval from centre to centre ... 5 feet.

$$d = \sqrt[4]{\frac{500 \times 2 \times 20^3}{72}} = 18{\cdot}25 \text{ or } 18\tfrac{1}{4} \text{ inches}$$

$$\text{and } b = \frac{d}{2} \; \frac{18{\cdot}25}{2} = 9{\cdot}125 \text{ inches.}$$

Scantlings 18" × 10" inches.

The foregoing results are tabulated in the table annexed.

Table of Scantlings of Deodar timbers for Flat Roofs, calculated by Rai Bahadoor Kunhya Lall, C. E., late Executive Engineer, Lahore Division, P. W. Department, Punjab.

Span in feet.	Interval from centre to centre.	Scantlings.	REMARKS.
Rafters	or Kurrees.		These scantlings are for first class terrace roofing, which weighs about 100lbs. per s. ft. For mud roof coverings, it will be safer to make them same as for terrace roofing. For Saul timbers it will be sufficient to take the scantlings for 2 feet less of span ; for instance, for Saul beams for 16 feet span take the scantlings of Deodar for 14 feet. Beyond 20 feet trusses should be adopted instead of beams.
3	1	3" × 2"	
4	1	3½" × 2½"	
5	1	4" × 3"	
6	1	5" × 3½"	
7	1	5 × 3¼	
8	1	6" × 3¾"	
9	1	6½" × 4"	
10	1	7" × 4"	
Beams.			
10	5	11" × 5½"	
11	5	12" × 6"	
12	5	12½" × 6¼"	
13	5	13" × 6½"	
14	5	14" × 7"	
15	5	15" × 7½"	
16	5	16" × 8"	
17	5	16¼" × 8"	
18	5	17" × 8½"	
19	5	17½" × 8¾"	
20	5	18" × 10"	

LAHORE ; 1st *December* 1886. K. L.

NOTES FROM HOME.

(From our own Correspondent.)

GREAT efforts are again being made to urge the Government to abolish the coal dues of London, described by a former Chancellor of the Exchequer as opposed to public policy and financial wisdom. The tax undoubtedly bears hard on the mining industries. It is charged equally on all qualities of coal coming into London, whereby the inferior kinds pay 50 per cent. of their value. It has to be remembered that the revenues arising from these dues pays for the great improvements of the metropolis, which therefore indirectly contributes, perhaps directly, to the prosperity of the metropolis itself.

Papers upon "Marine Temperature Observations" and "Notes on taking Meteorological Observations on Boardship" were read at the ordinary meeting of the Royal Meteorological Society on the 16th. After the reading of these papers a very interesting exhibition was held of Marine Meteorological instruments and apparatus, and of such new instruments as have been invented and first constructed since the last Exhibition.

The Meteorological Council has just published the first part of a series of Synchronous Weather Charts of the North Atlantic and the adjacent continents which are in course of preparation for every day from August 1st, 1882, to August 31st, 1883. In these there are on an average observations from rather more than 400 ships scattered over the North Atlantic for each day, besides which daily observations have been used from 300 land stations. The area embraced extending from the Pacific Coast of North America in the West to Central Russia and from the Southern part of the Arctic Regions on the North to the Equator on the South. These Charts are of an entirely novel character, especially from the amount of data they contain, no such mass of observations over the ocean having been previously collected. The information for a single day is contained on two Charts. One gives the height of the Barometer by the aid of isobars with the direction and force of the wind and also the state of the weather. The second Chart gives the temperature of the air and of the sea surface water, the weather being also repeated. It is thus possible to trace in a graphic manner the origin and progress day by day of the larger and more pronounced disturbances. And besides the elucidation of the weather changes over these Islands, these Charts must serve to afford material for fresh scientific inquiry as they will throw considerable light on all meteorological investigations.

The recent successful trial at Enfield of the Maxino machine gun has been followed by an announcement that its manufacture is about to be undertaken by an eminent English manufacturing company. At the trials referred to these guns of ·45 calibre exceeded the Government requirements. One weighing 50lbs. discharged 1,000 rounds within the 4 minutes, another of the same weight 1,000 rounds in 3 minutes 25 seconds, and a third which only weighed 42lbs. discharged 1,000 rounds in 1 minute 30 seconds. These guns were all exposed to the sand and rust tests, which in no way affected their efficiency. Though in rapidity of fire it may be equalled its immunity from jamming and missfires is claimed to place this system above others.

The members of the Committee which has for some months been inquiring into the administration of the Ordnance factories are about to visit some of the important private manufactories in the country. Lord Morley and his colleagues will inspect the great works of Sir W. Armstrong and Co. at Elswick and proceed to Sheffield, Manchester, Crewe and Birmingham. The object of these visits is to compare the methods of management adopted in private enterprise with those that have been pursued in the Royal Establishments.

Some interesting particulars relative to Steam Tramways and of the systems that are adopted by the three companies into which the Tramways of that City are divided are given in the *Engineer*. The engines used on these lines are made by Kitson of Leeds, Beyer and Peacock and the Falcon Engine Works, Loughborough. The rail used in all cases is Gowan's grooved girder rail. Particulars are also given of the Central Co.'s Main Depôt.

The meeting of the British Association is to take place at Manchester commencing on August 31st. The President will be Sir Henry Roscoe and the meeting promises to be a good one, for as the subscriptions are reported to be coming in well, the excursions, visits and other entertainments will be carried out on an exceptionally liberal scale.

From America we learn that the present prospects promise a year of special activity in Railway construction. Railway building there is reported to be about double what it was at this date last year. The Rail mills have very little capacity unsold between this and the 1st of next September. New mills will be built this year and the capacity of nearly all the others is being extended.

It was resolved at a recent meeting of the London Chamber of Commerce to form a section to represent branches of the Engineering trades.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

India, April 16, 1887.

Rajputana.

Rai Sahib Gopal Chundra Chattopadhyay, Assistant Engineer, 1st grade, Assam, is transferred to State Railways and his services placed at the disposal of the Government of Bengal.

Mr. A. T. Chiodetti, Assistant Engineer, 2nd grade, State Railways, is transferred from the Establishment under the Government of Bombay to that under the Chief Commissioner of Burmah for employment on Railways.

Mr. E. W. S. Douglas, Executive Engineer, 3rd grade, North-Western Provinces and Oudh, temporarily employed on State Railways under the Government of Bombay, is retransferred to the North-Western Provinces and Oudh.

The Governor General in Council is pleased to order the following promotions and reversions among the Executive and Assistant Engineers attached to State Railways, with effect from the dates specified.

W. H. P. Sherman, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 1st August 1886.

Mr. H. B. Addis, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade. sub. *pro tem.*, with effect from 1st August 1886.

Captain H. O. Selby, R.E., Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 1st August 1886.

Mr. B. P. Milson, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 1st August 1886.

Mr. G. F. Lamb, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 1st August 1886.

Babu Bhoobun Mohun Bose, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 1st August 1886.

Mr. W. Michell, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st August 1886.

Mr. W. Sivewright, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st August 1886.

Mr. E. H. Clementson, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 1st August 1886.

Mr. H. S. Talbot, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 1st August 1886.

Mr. W. S. Haig, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 18th August 1886.

Mr. E. J. Alexander, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 4th September 1886.

Mr. W. R. Shaw, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 5th September 1886.

Mr. G. Mills, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 9th September 1886.

Mr. G. Deuchars, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 12th September 1886.

Mr. G. Deuchars, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 1st October 1886.

Mr. P. T. S. Large, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 1st October 1886.

Mr. J. Elston, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 1st October 1886.

Captain J. Burn-Murdoch, R.E., Executive Engineer, 4th grade sub. *pro tem.*, to be Executive Engineer, 3rd grade, sub. *pro tem.* with effect from 1st October 1886.

Mr. R. S. J. Routh, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 1st October 1886.

Mr. J. F. H. Collet, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank with effect from 1st October 1886.

Mr. G. Deuchars, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 6th October 1886

Mr. G. Deuchars, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 13th October 1886.

Bhoobun Mohun Bose, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent rank, with effect from 14th October 1886.

Mr. W. S. Haig, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 14th October 1886.

Mr. G. Deuchars, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 14th October 1886.

Mr. H. S. Jones, Assistant Engineer. 1st grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade, permanent rank, with effect from 14th October 1886.

Mr. G. Deuchars, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 15th October 1886.

Mr. G. Mills, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 21st October 1886.

Mr. W. R. Shaw, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 26th October 1886.

Mr. E. J. Alexander, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 3rd November 1886.

Mr. R. C. Dyson, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 17th November 1886.

Mr. J. F. H. Collet, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 29th November 1886.

Mr. C. J. Cole, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 8th December 1886.

Mr. H. G. S. Savory, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 11th December 1886.

Mr. E. H. Tuck, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 12th December 1886.

Mr. P. P. Rogers, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 14th December 1886

Mr. H. W. Bennet, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 15th December 1886.

Major A. D. McArthur, R.E., Executive Engineer, 1st grade, Bengal, is appointed to officiate as Superintending Engineer of the Sone Circle during the absence of Mr. C. W. Odling on privilege leave, or until further orders.

Mr. F. B. Hebbert, Executive Engineer, 3rd grade, State Railways, temporarily employed in the Simla Imperial Circle, is appointed Officiating Deputy Consulting Engineer to the Government of India for Guaranteed Railways, Lucknow.

Mr. W. Causley, Honorary Assistant Engineer, 1st grade, is transferred from Rajputana to Hyderabad.

Mr. H. J. A. Bowden, Assistant Engineer, 1st grade, passed the Departmental Standard Examination prescribed in the Public Works Department Code.

Bombay, April 14, 1887.

Major W. Osborn, R.E., Executive Engineer, 1st grade, is allowed furlough, on medical certificate, for one year.

H. E. the Governor in Council is pleased to make the following promotions in the Engineering Establishment, *vice* Major-General J. LeMesurier, R.E., who has vacated his appointment under the regulations, with effect from the 24th March 1887 :—

Colonel A. T. Mander, R.E., to be Superintending Engineer, 1st class, permanent

Colonel W. M. Ducat, R.E., to be Superintending Engineer, 2nd class, permanent.

Mr. G. N. R. Lambert, to be Superintending Engineer, 3rd class, sub. *pro tem.*

Mr. J. A. Coghlan, to be Executive Engineer, 1st grade, permanent.

Mr. E. K. Reinold, to be Executive Engineer, 2nd grade, permanent.

Mr. J. G. Single, to be Executive Engineer, 2nd grade, sub. *pro tem.*

Captain E. C. Spilsburry, R.E., to be Executive Engineer, 3rd grade, permanent.

Mr. C. N. Clifton, to be Executive Engineer, 3rd grade, sub. *pro tem.*

Khan Saheb F. C. Tarapurwalla, to be Executive Engineer, 4th grade, permanent.

Mr. E. F. Dawson, to be Executive Engineer, 4th grade, sub. *pro tem.*

N.-W. Provinces and Oudh, April 16, 1887.

Buildings and Roads Branch.

Mr C. C. S. Clark, Assistant Engineer, 1st grade, passed the Departmental Standard Examination in Hindustani, on the 12th April 1887.

Irrigation Branch.

Mr. H. Nelson, Executive Engineer, 4th grade, sub. *pro tem.*, is appointed to the charge of the Rohilkhund Canals, during the absence of Mr. J. L. Tickell, Executive Engineer, on three months' privilege leave.

Punjab, April 14, 1887.

Mr. A. E. Orr, Assistant Engineer, 2nd grade, passed on the 1st March 1887, the Departmental Examination prescribed in Public Works Department Code.

Central Provinces, April 16, 1887.

Consequent on the reduction of the Saugor Division, General Branch, Captain J. C. Addison, R.E., Executive Engineer, 3rd grade, is transferred to the charge of the Hoshangabad Division.

Bengal, April 20, 1887.

Establishment—Railway.

Mr. R. A. Way, Executive Engineer, 2nd grade, sub. *pro tem.*, Tirhoot State Railway, is granted 3 months' privilege leave, with effect from the 1st May 1887.

Establishment—General.

Baboo Rakhal Dass Chatterjee, Assistant Engineer, 1st grade, attached to the Dacca Division, is granted furlough for 6 months, from such date as he may avail himself of it.

With reference to Government of India, Public Works Department, Notification No. 113 of the 11th April 1887, Rai Sahib Gopal Chundra Chattoradhyay, Assistant Engineer, 1st grade, is posted to the Eastern Bengal State Railway.

Mr. W. Connan, Inspector of Local Works, Presidency Division, is appointed to officiate as Inspector of Local Works, Dacca Division, in addition to his own duties, during the absence, on furlough of Mr. J. W. Johnson, or until further orders.

Under the power vested in him by section 123 of the Bengal Local Self-Government Act of 1885, the Lieutenant-Governor is pleased to appoint Mr. J. T. Simpson, Executive Engineer, 2nd grade, to be Inspector of Local Works in the Chittagong Division.

Mr. F. Sills, Executive Engineer, 2nd grade, attached to the office of the Superintending Engineer, Eastern Circle, is appointed to be Executive Engineer of the Chittagong Division, *vice* Mr. J. T. Simpson.

Assam, April 16, 1887.

In continuation of Orders dated the 14th January 1887, granting an extension of sick leave up to 7th April 1887, to Rai Sahib Gopal Chandra Chattapadhyay, B.A., Assistant-Engineer, First Grade, a further extension of three months' sick leave, on medical certificate, is granted to this officer, with effect from 8th April 1887.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

The 28th March 1887.

60 of 1886.—Edward William Serrell (Jr.), of the City, County and State of New York, in the United States of America, at present Commorant in Chabeuil (Drôme), in the Republic of France.—*For an improved mechanism denominated in French "lance-boat" employed for reeling silk.*

61 of 1886.—Edward William Serrell (Jr.), of the City, County and State of New York, in the United States of America, at present Commorant in Chabeuil (Drôme), in the Republic of France.—*For improved processes and combinations of mechanism and their working, to be applied to machinery for the automatic reeling of silk.*

87 of 1886.—George Hopkin Wells, of 48, Monmouth Street, Sheffield, in the County of York, Coach Smith.—*For an improved Lock-nut for Railway purposes or otherwise.*

159 of 1886.—Madho Ram Ojha, late Sub-Engineer, Public Works Department, resident of Mainpuri.—*For improvements in punkhas.*

165 of 1886.—Richard Morris, of Blackheath, in the County of Kent, England.—*For safety appliances for rifle ranges.*

192 of 1886.—Robert William Page, of London, England, Engineer.—*For improvements in muscular power or strength-testing machines.*

196 of 1886.—Edgar Bluck, Military Tailor, of 16 and 17, Old Cavendish Street, in the County of Middlesex, England.—*For improvements in coverings for the head such as hats and caps.*

233 of 1886.—John William Colton, Alfred Cutting Colton and William England Longbottom, trading under the style or firm of Messrs. J. Colton and Company, of Adelaide, in the Province of South Australia, Merchants.—*For a combined water filter and cooler.*

3 of 1887.—Thomas Large Henly, of No. 57, Charing Cross, London, in the County of Middlesex, England, Gentleman.—*For improved means and apparatus for heating and maintaining an equable heat in flax-steeping tanks.*

4 of 1887.—Conjeveram Chellapa Naicker, Bricklayer Maistry, residing at No. 47, Seven Wells Street, Black-Town, Madras.—*For raising water from wells, springs, &c.*

5 of 1887.—Josiah McGregor, of 78, Queen Victoria Street, in the City of London, Engineer.—*For improvements in stern wheel steamers.*

18½ of 1887.—Thomas Hill, Proprietor, T. Hill and Company, Tobacconists, Calcutta.—*For an improved box or receptacle for containing tobacco or snuff.*

The 4th April 1887.

9 of 1886.—Sandford James Kilby, Superintendent of the Customs Preventive Service and Salt Department, Calcutta. Amended specification of his invention.—*For facilitating the hoisting, weighing and discharging of salt, coal, metals, grain or any other material.*

152 of 1886.—Henry Hamilton Remfry, Solicitor and Patent Agent, of 5, Fancy Lane, Calcutta.—*For improvements in telephone transmitters.*

175 of 1886.—Max Pavel, of Cawnpore, Tanner.—*For an improved method for extracting the tan or tannin from the Babool and other tan-yielding barks, and for the appurtenances therefor.*

56 of 1887.—Louis Jacques Henri Cellerier, of Asnieres, France, Photographic Chemist.—*For improvements in the production of coloured photographs.*

40 of 1887.—Herbert Lambert, Engineer, of 4, Regent Terrace, Leeds, and George Greenwood, Machinist, of 8, Beech Grove Terrace, Leeds, both of the County of York, England.—*For improved apparatus for expressing oil from oil-yielding vegetable substances and converting the residue into oilcake.*

41 of 1887.—Frederick Sanders, of St. Petersburg, Russia, Merchant.—*For improvements in the system of removing sewage, &c., from cess-pools, sinks, and the like.*

Notices.

The Office of Publication of Indian Engineering *is at the* "STAR PRESS," *19, Lall Bazar, Calcutta.*

All communications should be addressed to PAT. DOYLE, C.E., *Spence's Hotel, Calcutta.*

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Answers to Correspondents.

INVENTOR.—In our next.

Obituary.

BROWNING.—At Nudrai, on 13th April 1887, Thomas J. Browning, late of P. W. Department, aged 46 years and 6 days.

FIGG.—At Tremezzo, Italy, on 25th March 1887, Henry Figg, C.E., late of India, and youngest son of the late Lieutenant-Colonel Figg, R.E.

INDIAN ENGINEERING.

SATURDAY, APRIL 30, 1887.

THE BOMBAY P. W. D. SECRETARYSHIP.

THE following startling paragraph is taken from the *Times of India*:—"There is an astonishing rumour abroad, *i.e.*, that Government actually propose to appoint a member of the Covenanted Civil Service to be Secretary to Government in the Public Works Department. Such an appointment would be a grave injustice. It would stop one step all through the Bombay Public Works Department in which promotion is already incredibly bad and the pay out of all proportion poor in comparison with the intellectual and educational attainments of the men. It would further take away the only prize in the department. It would still further enforce the retirement of every single Colonel who happens to become a Major-General; in fact, it is such an extraordinary proposal that we could hardly believe that Government really contemplate it, were it not for what we know the Government propose to do with the Chief Presidency Magistrate."

We hear from information received subsequently from Bombay, that Mr. Lee-Warner will probably be General Goodfellow's successor, if a Covenanted Civilian be appointed Secretary to Government in the Public Works Department. But we need hardly point out to the Department at large, that such a proposal should be resisted tooth and nail. It has been remarked that the Rawul Pindi Civil Engineers' Defence Committee have of late been doing nothing for the large subscriptions received by them beyond circulating pamphlets on the "Currency Question" to their contributors. No doubt it is most desirable that everyone in India should attempt to grasp this, the burning question of the day; but in the unjustifiable proposal of the Bombay Government, the Committee have a case made, as it were, to their hand, and to overthrow which they should spare neither time, money, nor energy. Every atom of influence at their disposal in Parliament, the Press, and the Institute of Civil Engineers should be utilised to the utmost; and it should be remembered that, on this occasion, Military and Civil Engineers can fight shoulder to shoulder, and join together in upholding the status and dignity of the Public Works Department in India.

We should remind our interested readers, that if this appointment is made, it will create a most dangerous precedent; for if it once be conceded, that a Covenanted Civilian can act as Secretary to the Department in Bombay, what is to prevent the application of the same principle in other administrations? And what makes the proposed appointment all the more startling, is the fact that the Governor of the Province, being an outsider to all the Services—is, or ought to be, quite uninterested and unprejudiced in the matter. We must admit that we are quite unable to understand Lord Reay's action in this matter. If it is seriously meant to assert—which we can hardly believe to be the case—that there is no Engineer, Military or Civil, on the Bombay

side, capable of undertaking the duties of Secretary in the Public Works Department, there are plenty of men in Railways or other Branches quite equal to the situation; and in addition to this, we would draw attention to the fact, that from Executive Engineer 1st grade upwards all the members of the Department are brought on to one general list for promotion by the Government of India.

We can only characterise the proposed appointment as a most gratuitous insult to a whole body of public servants, who are the equals of any other branch of the Services in point of ability, education, and social position. This idea of the infinite superiority of the Covenanted Civil Service over any other, and the suitability, as well as adaptability, of its members for any or every big appointment in India, should be exploded at once, and with no gentle hand. If Lord Reay persists in providing for his particular Dowb at the expense of a whole Department, we trust that Sir Theodore Hope will interfere through the Secretary of State; failing which, we hold it to be the duty of every man in the P. W. D. to protest, in as forcible a manner as he possibly can, against what we can only characterise as a scandalous piece of jobbery.

THE DEVELOPMENT OF INDIA.

Some passages in Mr. Jeans's paper read before the East Indian Association, to which we referred in our last issue, bring forcibly to our mind the old and popular saying, "as the statist thinks so the bell clinks." We do not, however, mean to suggest that he has consciously distorted figures to serve his purpose; on the contrary, we think Mr. Jeans has made out a strong case for himself. But it is nevertheless true, that the same facts when contemplated from another point of view might be adduced in support of a different theory. He lays undue stress on the authority of General Strachey, who estimates the benefit to the people of India from railways already constructed at from thirty to forty millions annually. Our past experience leads us to receive with certain reservation the dicta laid down by any of the Stracheys—the manipulation of figures in regard to the Afghan campaign of 1878-79 in the Indian Budget, during the close of the last Beaconsfield ministry, is an instance in point.

Far be it from us to deprecate the development of the railway system in India; there can be no doubt that, under conditions, they are and will be an enormous boon to the country, and play an important part in its material progress, but it can hardly be expected to accomplish everything that the puissant Secretary of the Iron and Steel Institute tries to prove. The following is one of several overdrawn pictures in the address with which he regaled his hearers. He says:—"With railway facilities there is no good reason why the 100,000,000 acres of cultivable land now lying waste for lack of such facilities should not be brought under cultivation. Let the land be let at an average of only 2*s*. per acre, and it will directly yield an annual revenue to the Government of £10,000,000 sterling a year. But the indirect gain would be still more considerable. The revenues of India would be improved all along, thriving industries would increase and multiply, our export trade would receive an enormous impetus, for it need not be pointed out that, if we drew upon India for the whole of the 24,000,000 cwt. of corn now imported from America, we should correspondingly increase our export trade, as well as give the people of India an opportunity of stepping out of the poverty and wretchedness that is now their portion, and stepping upon to an altogether higher and more prosperous condition of existence."

From a purely theoretical point of view the picture is admirable, and the reference to the people of India, touching; but there are some difficulties in the way of realising this beautiful dream, which have not been taken into calculation. That man is a benefactor of the human race who could make two blades of grass grow where one is grown now, but here is a magician who, by the mere flourish of his wand, converts, in the space of a few seconds, one hundred million acres of howling desert into a veritable paradise overflowing with milk and honey. When a visionary and an enthusiast dabbles in practical politics the result is lamentable. It is true railways exercise great influence in saving the inhabitants of remote provinces from the recurrent risks of famine, but at the same time it should be considered that railways also take away food grains in a season of plenty to bring it back in a time of scarcity with the addition of extra charges. But let that pass. What we are at present concerned with is the accusation of culpable neglect preferred against the Government, and the arguments adduced by Mr. Jeans in support of his position. He says that with the present price of materials (there has been a great depression in the iron and steel trade at home) the cost of construction would not exceed £7,000 per mile, while in 1885 the 'average' net receipts per mile then in operation were as much as £800, or a return of nearly twelve per cent. on the investment. This was a haphazard statement, inasmuch as statistics show that some of the larger lines, running through populous parts of the country, do yield large receipts, while on the other hand there are lines that pay from a quarter to a half of the above mentioned premium.

Those who endorse the views of Mr. Jeans of course find fault with the Government as being two niggardly in the matter of expenditure for such a useful purpose as that which in advocates. But they should bear in mind that, as a whole, the Indian railway system does not yet pay its way. And handicapped as the Government is with heavy liabilities on this account, would it be advisable to launch into large schemes of railway extension? We admit that India offers a very large field for private enterprise in this direction, and instead of clamouring for the construction of more railways does it not stand to reason that if traders and capitalists have persuaded themselves to believe that good profits await the investment, they should embrace the opportunity of reaping a rare harvest, instead of continually dinning into the ears of Government, both at home and here, that they are guilty of a grave dereliction of duty in not covering India with a

net-work of railways? Why all this Quixotic tilting at the ruling power, because they refuse to undertake risks which capitalists decline. If the scheme is really paying, why should not private enterprise step in unless it is blind to its own interests?

The real difficulty lies in the fact that Government will not grant all the concessions demanded, for a simple reason that too much foresight cannot be exercised in opening out new lines through sparsely populated and uncultivated tracts, the material resources of which are yet an unknown factor. The danger is great, and to start on a venture without calculating the attendant risk would be tantamount to courting disaster. It might be said that under any circumstances the money is spent in India and the people ultimately profit by it, and that the loss will be borne by those who undertake the chance; but this is not enough; any failure brings along discontent with it, and one unsuccessful experiment will act as a deterrent in the case of others which might be profitable investments. But Mr. Jeans eliminates all these elements from a consideration of the subject. He looks only upon the bright and hopeful side of the picture, ignoring the reverse with the calmness of a philosopher.

ARCHÆOLOGICAL OPERATIONS IN SOUTHERN INDIA.

To the uninitiated the science of archæology is inseparably associated with coffins, tombstones and other horrible relics of a past generation, but to the scientific enquirer it opens up quite a world of study and speculation. The Madras Presidency, as is well known, is peculiarly rich in archæological remains. This Presidency has for years yielded some of the most interesting relics of a by-gone civilization, in the shape of architectural remains, ancient inscriptions, coins, &c. Dr. J. Burgess, Director General of the Archæological Survey of India, has just submitted an interesting report on the results of his researches in Malabar, Quilandy and Palghat, and other places. He has at the same time forwarded the report of Mr. Rea, his First Assistant, and both afford interesting reading. At Quilandy Dr. Burgess visited the most ancient sites, and copied inscriptions in the Vattelutu and Malayabin characters. He next visited some of the notable Chalukya and Hoysala temples in Mysore, as well as the ancient stone circles and graves at Pallavaram, in company with Dr. Hultzsch and others. The latter managed to collect a number of old Chola inscriptions. Mr. Rea's report states that at Mahaballipuram, he made a few excavations and discovered a temple hitherto unnoted by any one, and after removing the soil in front, exposed the façade of the temple to view. He considers that this ancient temple is certainly coeval with the cave itself found in this part. He also excavated a small structural temple near the village of Mahaballipuram, with 16-sided fluted piers in the front façade and though small, the temple is an interesting and important one, as affording an example by which it may be possible to decide on the relative ages of these Pallava monolithic and structural temples. At a place called Saluvankuppain, Mr. Rea thinks there are numerous ancient remains as yet undiscovered, as traditional and other evidence points to this place as the site of an ancient seaport. Mounds and rocks, at present covered with sand, may, when judiciously excavated, bring to light curious relics. These mounds abound in the neighbourhood of both Saluvankuppain and Mahaballipuram. On the hill of Koilasogiri there is a cave believed by the natives to contain demons. This Mr. Rea visited, and found to be a natural cave, without architectural work or inscriptions of any kind. This neighbourhood appears to be particularly rich in archæological remains, which " lie about the fields in different directions, and the cultivators are said to be continually coming upon red sandstone pieces of building projecting out of the soil. In excavating a sunken passage around the temple of Vellore, some interesting articles were discovered embedded three feet in the soil. These were a black stone image of Ganesa 4¾ inches high, a small black stone weight, and a curious earthen pot with three handles, said to be used for oil. Who knows but that this very idol of Ganesa was worshipped by some ancient monarch of the Pallavas, and the earthen vessel might have illuminated the temple devoted to the god Ganesa. Among other interesting remains, an old Mahomedan palace was found at Abdallapuram, three miles west of Vellore. Who was Abdalla, and when did he reign? Perhaps Mr. Rea or Dr. Burgess might be able to tell us. In connection with the discovery of these ancient remains, the Archæological Department might render its reports of considerable interest by briefly assigning such 'finds' to some age, so that the uninitiated might also find something to interest them in perusal. Mere notices of having discovered so and so, leaves people 'in the dark' as to the real value of such a discovery. We make this suggestion for what it is worth.

It is stated that the French Syndicate who undertook the construction of harbour works at Port Arthur have claimed an extra million francs on the ground that they were supplied with wrong measurements.

The match industry seems to be again holding up its head in Japan. There are now thirteen match factories in Tokyo. Female labour is chiefly employed, as many as 170 women being engaged by two factories alone. The aggregate daily production of the thirteen factories averages fifty bales of six hundred dozen each, or three thousand dozen in all.

On the 1st March the long telegraph line, extending through the provinces of Szechuen and Yunnan, was completed, and telegraphic communication may now be had through the principal districts and prefectures in the western and south-western parts of the Empire. As this line extends to almost the extreme western borders of the Empire, China is now connected from east to west, and north to south, by telegraph.

It is expected that the Hong-Kong Tramway to the Peak will be ready for use this month. The promoters are hopeful that it will prove a success. The two long ropes for this tramway, were made by Messrs. D. H. & G. Hooggie, Wearmouth Rope Works, Sunderland. The incline where the ropes have to work is 4,800 feet long, laid with 35 pound steel rails on steel sleepers, the line being partly single and partly double; the gradients varying between 1 in 2 and 1 in 10, following closely the natural contour of the ground. The total height the carriages have to be raised is 1,300 feet. The ropes run on separate sets of friction rollers, the one a working rope and the other a safety rope. The carriages are attached to each end of the ropes, and as one pair of carriages ascends the incline, the other pair descends. Each car is to contain sixty passengers, the maximum load being seven and a half tons at each end of the ropes. The working rope is passed over a pair of drums eight feet in diameter, and the safety rope over one drum, the drums being fixed at the top of the incline and driven by two compound steam engines, forty nominal horse-power each. The speed of the cars is to be six miles an hour.

Notes and Comments.

MR. T. E. OWEN, EXECUTIVE ENGINEER.—The friends of this gentleman will be glad to learn that the recent rumour relative to his capture by dacoits in Burmah is unfounded. A telegram received on the 23rd instant says that he is "All right."

THE INDIAN MILLING INDUSTRY.—There were 89 cotton mills at work in India in 1885-86, of which the Bombay Presidency alone had 67. There were 24 jute mills at work during 1885-86, of which 23 are in the vicinity of Calcutta. The former represent nearly 300 lakhs of capital, while the cotton mills represent 1,000 lakhs. There are four woollen mills, of which one is a private concern.

GUNDUCK BRIDGE.—We see from an advertisement that the Gunduck bridge was opened for general traffic on the 25th April, just a *month*, we believe, after its inspection by the Consulting Engineer. What would people say in England if the officers of the Board of Trade took all this time to sanction the opening of a line of railway? The delay is all the more absurd in that the bridge was carried out by Government Engineers.

INSPECTOR OF LOCAL WORKS, BURDWAN AND ORISSA.—Babu Madhub Chunder Roy has been selected for the post of Inspector of Local Works to the Commissionerships of Burdwan and Orissa. This gentleman has the greatest reputation amongst all the Native Engineers of Bengal, and we feel sure that the results of the appointment will prove satisfactory. Mr. W. P. Milne will act for Babu Madhub Chunder Roy at Rajshahye.

MR. E. J. MARTIN, F.R.I.B.A.—We are glad to learn that the Consulting Architect to the Government of Bengal is quite restored to health again, and may be expected to resume duty in July next. We were pleased to see in a recent issue of *Invention*, the portrait of Mr. Martin among those of the most distinguishad Members of the Institute of British Architects, and the Memoir that accompanies it is a veritable record of Architectural Progress during the past quarter century in Bengal.

INDIAN COLLIERIES.—As an instance of the development of the natural resources of this country, the Indian colliery statistics afford interesting evidence. In 1885 there were altogether 95 collieries at work, of which Bengal alone had 90. There are two in the Central Provinces, two in Assam, and one in Central India. The total output of coal during 1885 was nearly 1,230,000 tons, of which Bengal alone contributed 1,123,700 tons. These mines give employment to something like 22,745 persons.

THE KATHIAWAR STATE RAILWAY.—Captain Gardiner, R.E., has been appointed to the management of the Kathiawar Railway, vacant by Mr. H. Dangerfield's death, and Captain Constable is officiating in the Railway Office. The P. W. D. Government of India Office is we hear in a hopeless state of confusion, owing to the delay in appointing a Secretary, but we hope Colonels Pemberton and Luard will succeed in getting things into order again in a short space of time.

PAPER-MAKING IN INDIA.—There are nine paper mills at work, five in the Bombay Presidency, two in Bengal, one at Lucknow, and one at Gwalior. Three out of the nine are private concerns, and the remainder show an aggregate nominal capital of Rs. 38,68,000. Six of the mills are reported to have produced paper to the aggregate value of Rs. 17,79,954 in 1885. Another mill, the "Deccan," will be opened next month at Poona, having a capacity of 5 tons a day. Madras is the only part of India where this industry is unrepresented.

SURVEYOR-GENERAL'S OFFICE EXTENSION.—The extension to the Surveyor-General's Office, Calcutta, referred to in our last issue, is to be proceeded with at once, and one and a half lakhs of rupees have been sanctioned for the coming year. In all probability the new building for the Mathematical Instrument Department will be started first, so as to allow of work being continued in the present building, until the new one is ready for occupation. The old house in Park Street will then be dismantled, to make room for the new Photographic Branch of the Surveyor-General's Office.

THE BOMBAY P. W. D. SECRETARYSHIP.—A Correspondent writes:—The name of the Covenanted Civil Servant who is to rule the P. W. D. in the Bombay Presidency has not yet transpired, and it is possible that the rumour is not true; but Civil Engineers of the Department need not be surprised at anything of this sort, as they are accustomed to injustice. It is remarkable that no one has yet been appointed to succeed General Goodfellow, R.E., who vacated the Secretaryship on the 31st March. Everyone throughout the Department has naturally been expecting to go up one place in his grade when the appointment was made.

MADRAS NEW HIGH COURT BUILDINGS.—A revised scheme for adding to the existing High Court buildings at Madras and extending them in the same line with other edifices on the beach, in its vicinity, having come before Government, the old question of a new set of buildings, which had been shelved for some time, has again cropped up. Two sites have been suggested as the most suited for the location of the proposed buildings. Upon the comparative figures submitted relative to their cost will greatly depend the selection of the site for the new High Court buildings at Madras, a design for which Mr. Brassington, the present Consulting Architect, has been directed to submit at an early date.

MR. WILLIAM SULLIVAN HARRINGTON, M.I.C.E., MADRAS.—The Government of India have refused to confirm the appointment, made by the Madras Government, of Mr. W. S. Harrington as Executive Engineer, Ramnad Division. Mr. Harrington was, in 1880, on account of reductions in the P. W. D., thrown out of employ; but he was at once put on the Local Fund, and afterwards the temporary P. W. D., establishment. He has continued in the latter till the *fiat* of the Finance Commission, for the abolition of all temporary establishments, once more found him unemployed. But the local Government, as an exceptional and isolated instance, transferred him to the permanent establishment——with the result above noted. Mr. Target has been sent to relieve Mr. Harrington at Ramnad.

THE DEHRA DUN RAILWAY.—We hear that the Dák gari Company referred to in the "Current News" column in our last issue as being under formation in Mussoorie has not yet been floated. Moreover, we are informed that the avowed object of the movement was to break down the combination of the three existing native *dák gari* proprietors, under the *ægis* of the district civil authorities, to exact high fares, and that some of the leading promoters of the railway scheme subscribed for shares in the projected new company with that view, and not from despair of the railway scheme. The project for the railway, as mentioned in an editorial note in our issue of 9th instant, is now before the Local Govern-

ment, and orders on it may shortly be expected. The scheme in fact is almost ripe for the London market.

Sic vos non vobis nidificatis aves.—A contract was signed by H. E. Chou-fu and M. Thevenet, before they left for Port Arthur, for the supply of two pumping dredgers for the Yellow River at a cost of Tls. 145,000. The precedent of the Port Arthur contracts has, we are informed, been strictly followed, maps, drawings, and specifications were compiled by a competent foreign engineer from observations on the spot, made at his own cost, without which it would have been impossible to design the machines at all, and when after much negotiation and some expensive telegraphing, the business was brought to the point of completion, the Chinese officials handed over the maps and papers to M. Thevenet, who was invited to tender at a lower price and take the contract, which he at once did. It is further stated that the specifications drawn up by Engineer No. I have been textually accepted by the French Syndicate!

A Service Grievance.—We wish to draw attention to a grievance which is bitterly complained of throughout the Public Works Department. For some reason or other, it has been customary recently to delay the publication of promotion gazettes for months together. A recent instance will be found in the last promotion gazette issued by the Government of India a few days ago. Some of the officers who have reverted will have to refund back pay drawn in good faith for nearly four months. In one case the gentleman concerned will on this account receive no pay whatever next month, unless he is allowed to refund the overdraft in instalments. This is distinctly wrong, and we can see no reason why the promotion lists cannot be kept up to date, so that promotions and reversions can be made as soon as they are due—especially in these days of promotion by seniority. It is pleasant enough to have drawn arrears of back pay, but it is no joke to have to refund it after it has been spent.

The Ferozepur Bridge.—The bridge over the Sutlej at Ferozepur is expected to be ready for railway traffic on the 30th instant, when it will be opened by Mr. J. B. Lyall, Lieutenant-Governor of the Punjab. The new bridge is as long as the Empress Bridge lower down the river, and though its spans are not so great nor its foundations so deeply sunk as some of the other notable works of this kind that this present Jubilee year will see come into completion, its 6,000 tons of steel girders with masonry work and protective stone embankments to match, costing in all 45 lakhs, make it a sufficiently imposing and important undertaking. Being an important feature in the Frontier Railway scheme, it has been pushed on lately as fast as was consistent with economy, and instead of the three or four years that its construction seemed likely to occupy, it will have been completed in very little more than eighteen months. The upper deck for carrying a cartroad and footways will, it is hoped, be finished off before the rains.

A Special Degree in Sanitary Science.—The majority of the members of the medical faculty of the Madras University opined that the time has arrived for the institution of an examination in State Medicine (Sanitary Science) by the University, and that a degree or diploma should be granted to graduates or licentiates passing in it. We are disposed to endorse the views of Dr. Bidie on this subject, *viz.*, that the measure is premature—merely ministering to that intense craving for academical qualifications, irrespective of their practical value, which possesses the native mind. He says that the few real sanitarians who are required in India for administrative purposes are and must be supplied from Europe, and speaking as a practical Sanitary Officer of some experience, he thinks that we do not want vapouring doctrinaires, but efficient Sanitary Inspectors, men with a keen nose for bad smell, and sharp eye for matter in the wrong place. The scheme of technical education now in force will for years to come provide the sort of men we really want and whom we can efficiently train in the country, so that we do not want a University degree in sanitation.

Indian Railways.—At the end of 1885-86 there were altogether 12,375 miles of railway open for traffic, and 3,764 miles in progress. Of the open lines 7,113 miles were State, and 4,574 miles guaranteed and assisted, while of those in progress 2,894 miles were State and 304 miles guaranteed and assisted. The Native States had 688 miles open for traffic and 506 miles in progress. The total earnings of all the Railways in the country amounted to Rs. 18,03,44,656 and the total expenses to Rs. 8,94,52,833, equal to 49·6 per cent. of the earnings, and leaving a net profit of Rs. 9,08,91,823, of which the East Indian Railway alone contributed nearly one-third. Next come the G. I. P., the B. B. & C. I., and the Rajputana-Malwa lines. These four, with a total of 4,665 miles, or not quite 38 per cent of the entire open mileage, earned nearly 70 per cent. of the aggregate net profits. The total number of passengers carried on all the lines increased from a little over 22 millions in 1873 to 77 millions in 1885, exclusive of season ticket holders. The goods carried increased from something over four million tons in 1873 to 20 millions in 1885, and of live stock from nearly 449 thousand head to 831 thousand head. The gross receipt from the passenger traffic alone amounted to Rs. 5,55,71,642 in 1885, or nearly double that in 1873, while the receipts from the goods traffic rose from 461 lakhs in 1873 to 1,193 lakhs in 1885.

The Battle of the Main.—We are sorry to observe a growing tendency of the Calcutta Municipal Corporators to revive the discussion in the new main, with the object, ultimately, of reducing the bonus to which the Engineering Department of the Municipality has not only established a claim, but which the Commissioners, by their own action, have committed themselves to uphold. The member who is ready to override the law in the matter of frittering away a large sum of money in Jubilee frivolities, hesitates to vote a few thousands to men who have worked hard for it, and saved the Corporation two lakhs, in their zeal to serve public interests. This is straining a gnat and swallowing a camel with a vengeance. We cannot but deprecate such a spirit in dealing with questions involving such grave responsibilities to the tax-payers. It would be worse than useless to re-open the question of the utility of the 48-inch main, or of its testing, as the subject has been worn threadbare in the solemn deliberations of the Calcutta civic fathers. What we would strongly impress upon the attention of the Water-Supply Committee, who have been asked to fix the bonus, and to settle the principles on which it should be allowed, is, that they must not lose sight of the fact, that a labourer is worthy of his hire, and that in such instances, where it is far more justifiable to err on the side of liberality than of misplaced economy, they should show a due appreciation of the eminent services rendered by their employés, and thus set a premium on the honesty of men upon whose untiring exertions depend the health and comfort of the city.

Current News.

At Jhansi, on Monday last, a shade temperature of 120 was registered.

Mr. H. B. Medlicott, Director of the Geological Survey, retires almost immediately.

Mr. F. B. Hibbert officiates as Deputy Consulting Engineer for Guaranteed Railways at Lucknow.

A Bill is under consideration for the protection of forests, waste lands, and grazing reserves in the Punjab.

Bombay wants to have a tramway made from the G. I. P. Railway at Narel to the top, Matheran Hill which is close to the Narel station.

The Public Works Department have sanctioned the estimate of the cost of levelling the main ramparts and out-works of Fort Mackeson, in the Peshawar Division.

Mr. J. A. Maughan, M.I.M.E., who has been Agent and Manager of the Nerbudda Coal and Iron Company for over ten years, is now going on furlough.

Mr. A Ewbank, Principal, Patna College, is allowed furlough for five months, with effect from the 15th May 1887, or such subsequent date as he may avail himsef of it.

It is notified for general information that under the orders of the Government of India, the sanitarium at Pyaunggaung, in the Ruby Mines District, will be called "Bernardmyo."

Colonel Wallace having reported that there will be no difficulty in at once obtaining labour in the Raipur district, the Nagpur-Bengal Railway will be commenced immediately.

In future Mr. Palmer's salary will be rated at the sum of Rs. 1,500 instead of Rs. 1,400, which he has hitherto drawn as Public Works Department Secretary, Hyderabad—Deccan.

After much talk and delay, a suitable hospital building will shortly be commenced at Nagpur. The foundation stone is to be laid by the Commissioner before he proceeds on furlough.

Major G Carre-Carter, R.E., Inspector of Sub-Marine Defences, will return to Bombay on completion of his duty in connection with the Sub-Marine Mining Service at Manora.

At a meeting of the Senate of the Bombay University H. R. H. the Duke of Connaught, *ex-officio* Fellow of the University, was appointed a member of the Faculty of Arts and Civil Engineering.

Colonel Sanford, Inspector-General of Military Works, and Colonel Lovett, from Rawal Pindi, paid a visit to Lundi Kotal and the Khyber Pass on the 17th, returning to Peshawur on Tuesday last.

Mr. H. F. Blanford, Meteorological Reporter to the Government of India, is granted furlough for a period of ten months, with effect from the 6th May 1887, or any subsequent date on which he may avail himself of it.

The Survey of India has recently lost a good and experienced officer in Lieutenant-Colonel T. T. Carter, R E, whose services were lately replaced at the disposal of the Military Department in anticipation of his retirement.

Opinion at present inclines to carrying the Sind-Peshin Railway over the Khwaja Amran by way of the Gwaja Pass from Gulistan Karez, the military road from Killa Abdulla to Chaman being at the same time greatly improved.

Mr. A. Pedler, Professor, Presidency College, is appointed to act, in addition to his other duties, as Meteorological Reporter to the Bengal Government, during the absence, on deputation, of Mr. J. Eliot, or until further orders.

It is reported that Mr. Alexander, Ex-Engineer at Bareilly, who was going to Allahadad to officiate for Colonel Swetenham, as Superintending Engineer of that Circle, has been nominated to represent the Government at the Ruby Mines in Upper Burmah.

The work of construction has commenced on the Northern Division of the Southern Mahratta Railway from Huryhar to the 155th mile on the Mysore line, 57 miles in length. The southern extension division works at Hubli will commence almost directly.

Mr. J. Eliot, Professor in the Presidency College, Calcutta, and Meteorological Reporter to the Government of Bengal, is appointed to officiate as Meteorological Reporter to the Government of India, during the absence on furlough of Mr. H. F. Blandford.

Estimates are being framed for the laying of rails on the triangle at Husan Sagar Junction to admit of the trains from Wadi in future running direct to Secunderabad instead of traversing an unnecessary portion of the line to Hyderabad and then returning.

It is notified that the Secretary of State for India offers fifteen appointments in the Indian Public Works Department and two in the Indian Telegraph Department, in respect of students who enter the Royal Indian Engineering College at Cooper's Hill during the current year.

The papers regarding the new contract for the conveyance by the P. & O. Company of the East India and China mails, which will come into force next year, were laid upon the table in the House of Commons on the day before the last mail left, and show that there will be a saving from next year of £107,000 per annum.

The work of jungle clearing in various districts in Burmah has been pushed forward considerably. It was expected that this would cost on an average Rs. 20 a mile, but now it is expected that the average will only be about Rs. 70 a mile. The amount of jungle cleared in districts varies from 200 miles in Minbu to 30 miles in Bhamo, or an average of 90 miles a district.

The appointment of a Deputy Controller of Stores, E. I. R., on a salary of Rs. 750 per mensem, which was approved by the Board of Directors of the East Indian Railway Company at Home, but disallowed by the Government, has been again proposed, and is likely to be supported by the Consulting Engineer. It is presumed that the scheme will now be sanctioned.

In the event of the Rajpura-Patiala Railway being included in the Imperial Railway system, the Patiala Durbar are desirous of retaining jurisdiction on the line. This, however, is not likely to be granted, as being contrary to the salutary rule that every line of railway included in the imperial system, although passing through native territory must be, for obvious reasons, under Imperial jurisdiction.

It has been decided that the working of the Nandiah section of the Cuddapah-Nellore State Railway will be carried out by the South Indian Railway from the 1st of July, when it is expected it will be ready for traffic. By that time the agreement between the State and the S. I. Railway Company for the purchase of this line of railway, which has been approved of by the local and the Imperial Governments, will have been confirmed by the Secretary of State.

The Behar-Assam Railway is making head, we are glad to hear. The local Government has sanctioned grants of sixteen lakhs of rupees for the Purneah and Dinagepore Division of the work, which is being pushed on with so great vigour that more than half-a-mile of road is being completed every day. The Purnobhola bridge is expected to be completed by the end of next month, when the line from Dinagepore to Raneegunge, distance about 30 miles, will be open for traffic.

The Dewan Regent of Pudukota has obtained sanction from the Government of India for the employment of Mr. C. H. Wilks, M.I.C.E., lately Executive Engineer of Negapatam, and for many years employed on the Kurnool Canal. It seems that the administration of this flourishing little State is determined to effect extensive improvements, specially in public buildings. A proposed railway from Tanjore to Pudukota, which promises to greatly benefit the State, has already been surveyed.

A Bombay paper states :—"It is understood that the delay in naming the successor to General Goodfellow in the Secretaryship to Government in the Public Works Department is owing to the desire to effect a radical change which may place the P. W. D. under some other department of the Government. Rumour has it that Mr. Lee-Warner is likely to succeed to the post. He would not be the first Civilian to hold the appointment ; but it has come to be regarded as an appanage of the Uncovenanted, except when it falls to the lot of a Royal Engineer."

Colonel Pemberton, R.E., the present Director-General of Railways, has been appointed Secretary to the Government of India, in the Public Works Department, and Lieutenant-Colonel Conway-Gordon, the recently appointed Manager of the North-Western Railway system, becomes Director-General of Railways. Colonel W. Wallace, Consulting Engineer, will probably succeed Colonel Conway-Gordon, Colonel Engledue replacing Colonel Wallace. Major Boughey, the Manager of the Eastern Bengal Railway system, shortly proceeds on furlough, when he will be succeeded by Major Sergeannt, who is now on his way out to India from leave.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

RAWUL PINDI WATER SUPPLY SCHEME.

Sir,—With regard to the water-supply scheme at Rawul Pindi may I ask you to give us sketch plans of the wells and their connections. All other details which would interest Engineers would be, I am sure, gladly received by the readers of your valuable journal. R.

[The Note furnished by us on this subject was an abstract of the original Report, which we may produce *in extenso* with other particulars should the demand on our space diminish.—Ed., *I. E.*]

PATENT ROOFS IN BENGAL.

Sir,—It is reported down here that several roofs formed of arches and tie rods have lately failed in Bengal.

As the results of the experiment carried out by Mr. Stoney have induced several builders to try these roofs, and as I propose to try them myself on an extensive scale, I and others would feel greatly obliged to you if you would kindly obtain and publish the details of the failures. R. F. C.

[We take it the Leslie roof is alluded to. To say that "several have lately failed" is, we think, a mistake. We *know* of one that failed in Naraingunge in 1879-80, due, in our opinion, to bad material—that is, to a faulty tie end in the nut. We have only *heard* of others having failed ; but that they *are* safe is shown in the acres and acres of them that are standing to-day. They require care in building and uniformity of loading in putting on the material. There are 15,000 s. ft. of them to our knowledge in one building alone in Calcutta. All that have failed, have failed, we have been told (as the opinion of the Patentee), in the course of contruction, showing that care is requisite in loading them.—Ed., *I. E.*]

ROORKEE FINAL EXAMINATION.

Sir,—A mistake occurs, in the "Notes and Comments" column of your issue of the 9th April, which you will, perhaps, like to correct.

It is not "for the *second* time in the history of the Thomason College," but for the *fourth* that a native heads the List. Up to the time the B. A. Examination was an indispensable qualification for entrance into the Engineer Class of the College, only two native students, *viz.*, Babu Krishna Chandra Bandopadhyaya and Lala Fakir Chand headed the List at two different times widely separated from each other.

But since the passing of the famous "Roorkee Resolution" (much modified subsequently) when the above restriction was removed, and every candidate, who passed the especial Entrance Examination of the College, became eligible to that Department, without his being a graduate, two more native students have stood first—Lala Rala Ram in 1886 with a very high percentage of marks and several subject prizes, and Mr. Chandu Lal this year as you have noticed.

The results of this, and of the last year, show, to a certain extent, the advantages of the removal of the restriction of a degree as one of the qualifications for admission to the Engineer Department, but time alone will prove the entire wisdom of the change.

Why our graduates did not do so well at Roorkee, as these undergraduates have lately been doing, I shall try to explain in a future correspondence.

Nagpur: *April* 17. An Ex-Student.

[We are obliged for the correction, and will be glad to hear from Correspondent again on this subject.—Ed., *I. E.*]

RECORDS OF GREAT ENGINEERING WORKS—WANTED.

Sir,—As bridge construction is one of the most important and interesting questions, with which the faculity has to deal in India, I venture to state that it is somewhat surprising that the Government of this country has not done more to give publicity with complete details for the information of the profession, of the many magnificent works recently constructed on the various State Railways within the last few years. We all know that such works as the viaducts over the Ràvi, Chenàb, Jhélam, Indus at Attock, Empress Bridge at Bhawalpur, the Chambal, the Gandak, and others too numerous to mention, have been constructed and open for traffic for some years past, and that others of equal magnitude and importance are rapidly approaching completion. Now these are all works justly to be described as some of the most magnificent triumphs of the British Civil Engineer, and perhaps, save America, there is no country in the world where such a superb collection of works as our Railway bridges out here are to be seen. I would ask *how many* of the Engineers serving in India have ever had the opportunity of seeing such works or becoming acquainted with the details or difficulties encountered in their construction? Ninety-nine per cent. of us have to content ourselves with the meagre description given by some "Special Correspondent" in the columns of his journal. We are told perhaps that the Pàghalpur bridge has so many spans of *x metres* each, that the wells were carried down below *x* feet bed of stream, so many thousand feet of masonry were executed in each well, so many tons of iron in each span. The girders are designed as what is known as a Howe or Whipple-Murphy or any other kind of truss, the first curb was pitched *x y z* B C, and the bridge open for traffic and completed *a b c d* A D. The Chief Engineer and his staff are, as is most just and proper, eulogised for their skill, energy and resolution in overcoming natural difficulties, and, "*voila tout*," this our worthy "special" most accurately chronicles, together with the facts that champagne, *Ayala* or *Veuve Clicquot's* best, claret cup, whisky and soda for the coarser palates, *mayonnaise, lobster salad, salmi*, etc., etc., were consumed to an extent approximating ∞. These are details highly edifying no doubt to the lay mind, but what the practical Engineer would like to see would be a serviceable record in the shape of drawings, plans and details on paper of work done both for guidance for the future and general information.

If I am serving in Bengal what chances have I of knowing much about the Indus bridge at Attock, or what is being done or has been done in the sister work at Sukkur; or if I am in the Punjab what information am I likely to gather of works done on the Rajputana or any Madras Railway? The Government keeps all this valuable information hermetically sealed, so to speak, and in this matter fails owing to a serious misconception of its duties to the whole Department collectively, than whom it has no abler or more devoted servants in the Empire. Indian Engineering has now stepped in to supply the place of the moribund Rurki papers. Private enterprise may do a great deal, but after all in a country like this, where *all* public works are paid and constructed from the Imperial "*fiscus*," the Secretary to Government of India, D. P. W., would do well, in fact, as our friend Mr. Pecksniff observes, more efficiently "*discharge the duty he owes to Society*," were the records of the great Engineering works past, present and now in course of construction made public.

Indian Engineering is, I believe, the only medium in India through which effect could be given to my suggestions, and I trust you will absolve me from the charge of impertinence if I ask you as Editor to memorialise the Government on this point, with a view to putting at your disposal for the benefit and information of your subscribers, drawings and records of some of the noblest "triumphs of mind over matter" to be found in the whole world.

At present you or I might, thanks to the action of Government, consult the sybilline books, an Egyptian hieroglyph, a Babylonian inscription, or a Ninevite scroll, if we wanted to know what is going on in the Engineering world in various parts of India, for all the satisfaction we could get.

It is just possible that owing to "some shallow spirit of judgment" I may be quite wrong, or as the apostle says I speak "*ἰδιώτης*" and the Government may not see the necessity of making public its own grand and enlightened efforts in the great cause of advancement, civilization and material progress of this Empire; but the "bold disjointed talk" which I have this morning indulged in, expresses the ideas of many Engineers now in this country, and trust you will pardon the length this epistle has assumed.

S. P. Q. R.

[We reserve our opinions and comments for a future occasion.—Ed., *I. E.*]

Literary Notices.

Quarterly Journal of the Royal Meteorological Society. January—1887.

The account of the International Congress of Hydrology and Climatology held at Biarritz in October last given by Mr. Symons is, perhaps, the most interesting portion of the contents of this volume. Dr. Durand epitomised the objects of the Congress in his opening address: "It must be thoroughly understood that the solutions of questions of climate can only be effected by co-operation. Isolated researches and fragmentary observations will not suffice, nor is it sufficient to bring together two observers or even two associations; country must join country, continent continent, for the whole globe is but their observatory and their laboratory." And the means to this end is doubtless an "assembly" of *savans* of all countries where each can contribute to the foundation of a definite and universal science of climatology.

We observe that Professor S. A. Hill, of Allahabad, furnishes a criticism of certain points of Langley's Researches on Solar Heat.

Transactions of the American Society of Civil Engineers. November—1886.

This number contains a Supplementary Paper by Mr. E. B. Dorsey confirmatory of the views enunciated in his former Paper on "English and American Railroads compared." The subject is of vast importance to railway interests. Mr. Dorsey compares the systems of the two countries, and makes a tremendous difference as to economy in operating between England and America in favour of the latter.

Mr. A. M. Wellington describes a Railway Line in Mexico with notes on the best methods of surmounting high elevations by rail. The element which appears to make the mountain grade of this line particularly worthy of note is that it is believed to be the longest continuous grade ever located—72·64 miles having been located on an unbroken 2 per cent. grade.

Arithmetic. *By Charles Pendlebury, M. A., F. R. A. S.* Cambridge: Deighton, Bell, and Co. 1886.

A cursory examination of this book has favourably disposed us towards it. Its predominant feature is the Unitary method, which is made to supersede Proportion. This is only the application of "first principles" or simple reasoning to questions usually solved by the "rule-of-three," or deducing the required result by the theory of fractions. In this and in other respects, the author is very happy in some of the changes he has made from the heretofore well beaten track. There is a simplicity and neatness in his style of dealing with the subject that cannot fail to render the work popular with those for whom it is intended. As far as we can glean it is a well devised and useful book, and we are glad to find that it has been already introduced into the Behar Circle of the Educational Department of Bengal.

General Articles.

SCHOOL OF ARTS—MADRAS.

III.

OUR drawing shows details in elevation of the Glass and Pottery Shed. The roof is an ordinary tiled one sloped lean-to, resting on a double row of columns on one side, and on the wall, of which our drawing is an elevation, on the other side. As this wall abuts on the road and continues the enlignment of the other portions of the building, it was considered fit to ornament it, though it formed the wall of only a humble shed.

Our drawing speaks for itself, and shows how easily, and without any extra expense, a bare wall can be made to look beautiful. The material is brick pointed with cement, and by projecting and indenting some of the courses, in bands, arches, and pilasters, light, shade, and variety have been given to what would otherwise have been a bare, dull, ugly looking wall. We would draw the particular attention of our readers to this method of ornamentation. The ornament is constructive, and therefore not out of place; it does not add to the cost, or detract from the strength of the wall; and best of all, it does away with the abominable plaster and daub that so many delight in, which so soon deface some of our best buildings with leprous looking blots and patches, or when new, give them the appearance of show and superficiality, clean without, but covering a lot of rotten unsafe construction within. We do not decry against plastering the inside of buildings, where the plaster can be painted or otherwise preserved. The bands of terracotta are the gift of the kind Superintendent of the School, and intended both as ornaments to the wall, as well as permanent advertisements of the work done in the School. The nitches in the wall are intended for statues. According to Ferguson and other high authorities, the external appearance of a building should speak its internal uses, and who will say that it does not do so in this instance? It is surprising that so little use is made of terracotta in India. It is manufactured in several places in this country, and nearly as endurable as stone. It can be glazed in almost any colour so as to harmonize with other parts of a building, and admits of moulding into any forms the architect or builder may choose.

The inner surface of this Shed wall is blackened and used as a black board for students in tinted glass, wood-carving, and terracotta. Visitors will here very often see the most beautiful designs drawn for one subject, such as a door, window, pannel, &c., by half-a-dozen different students, but all showing that profusion and elaboration peculiar to the Indian mind.

The Madras School is the only institution in India in which painted glass windows, &c., are manufactured. It was first taught by Mr. Chisolm, who went through the trouble and expense of learning it for himself in England that he may be able to teach it here. It seems an art peculiarly suited to native tastes, and it seems surprising that it was not known in this country earlier. An art that flourished in Europe under the very "shadow of barbarism" was not known in India till taught by Mr. Chisolm about six years ago! This seems incredible, but we believe it to be true. The cheapness of Indian labour, and fineness of touch of the Indian workman, ought to make the manufacture in this country nearly half of what it would cost in England, so that we trust this new industry has a great future before it, and that soon India instead of receiving will send glass windows to Europe. India, in receiving its civilisation from Egypt, imbibed also a good deal of its polychromatic tastes, as seen every day in the brilliant colours of Indian clothing. To such a people the lively colours, and absence of graduation of half tints, necessary in effective glass work, should have a special charm, so that we will soon expect to see bits of painted glass in most Indian houses. If Herr Brongmart earned the commendations of Europe for the revival of the art of glass painting after its almost total extinction in the 16th century, we may safely say that Mr. Chisolm deserves a great deal more for the introduction of the art into this country, and as honest chroniclers, we cannot too loudly proclaim this, in these days when honours are being distributed almost broadcast.

We before stated that the site of the school was well chosen. It stands next to the Kirk, which is supposed to be the central point in the "city of long distances," so that it is approachable with equal ease or difficulty from all directions. It faces a portion of the "Great Western Trunk Road," the historical road that travels *via* Arcot, Vellore, Bangalore, &c., right through the Peninsula. In the past century it was along this road, that were heard so often the loud sounds of wars' alarms, and on which marched those old English heroes to new battles and new victories, so that it was only fit and proper, that on the same old road should be built this "Temple of Peace," this school to the arts and sciences, that is to carry the country forward into a new bright history of peace and prosperity. A Superintendent who has graduated at Kensington has now charge of the school, and we trust he will make its light and learning felt in the remotest villages of this country.

J. H. S.

MEMORANDA OF INFORMATION REGARDING THE JODHPORE PUBLIC OFFICES.

FURNISHED TO COMPETITORS.

1. THE offices will be built on a large open piece of ground nearly level.

2. The foundations will be on sand or on hard kunker clay underlying the sand.

3. During the hot weather a wind blows from the south-west, and for the comfort of the inmates it would be well to have as many of the rooms as possible situated so, that tatties can be worked in them.

4. The building stone in Jodhpore is red sandstone of various shades of colour. The rates for work generally are as follows:—

Concrete ...	... Rs. 15 0 0 per % cubic feet.
Coursed rubble masonry ...	„ 20 0 0 do. do.
Cut Stone for string courses, cornices or other such works ...	... from Rs. 35 0 0 to Rs. 50 per % c. ft.
Plaster ...	... Rs. 4 0 0 per % s. feet.
Slab roofing ...	... „ 25 0 0 do.

The greatest span that slabs can be got to cover without arch or girder supports is 10 feet.

Timber framework roofing is little used in Jodhpore as wood is not easily procurable and so rates for it cannot be given.

5. The following is a schedule of the accommodation required, all of which should be in one double-storied building.

PRIME MINISTER'S COURT.	feet. feet.
1 Musahib Ala's Kutchery not less than	40 by 30
1 Room for clerks about ...	... 16 „ 10
1 Room about ...	... 30 „ 20
1 Secretary's Office about ...	... 20 „ 30
1 Bath-room.	

COMMANDER-IN-CHIEF AND MILITARY PAY OFFICE.	feet. feet.
2 Rooms	... 30 by 20
1 Do.	... 20 „ 20
1 Bath-room.	

DIWAN'S OFFICE.	feet. feet.
2 Rooms	... 20 by 20
1 Bath-room.	

APPELLATE COURT.	feet. feet.
2 Rooms	... 20 by 20
1 Bath-room.	

COURT OF SIRDARAN.	feet. feet.
2 Rooms	... 20 by 20
1 Do.	... 25 „ 20
1 Do.	... 16 „ 20
1 Bath-room.	

SCHOOL OF ARTS.

MADRAS

GLASS MAKING CARPENTRY AND POTTERY SHED.

SCALE 4 FEET = 1 INCH.

The "STAR" Press, 19 Lall Bazar St

Civil Court.		feet. feet.
1 Room	... ...	... 20 by 20
1 Do.	... ...	... 16 ,, 20
1 Do.	... ...	... 16 ,, 10
1 Bath-room.		
Foujdari Court.		**feet. feet.**
1 Room	... ...	... 20 by 20
1 Do.	... ...	... 16 ,, 20
1 Do.	... ...	... 20 ,, 20
1 Bath-room.		
Mahkma Tamil.		**feet. feet.**
1 Room	... ...	... 20 by 20
Mahkma Bakiyat.		**feet. feet.**
1 Room	... ...	... 20 by 20
Foreign Secretary's Office.		**feet. feet.**
1 Room	... ...	... 20 by 20
1 Verandah	... ...	... 15 ,, 10
1 Bath-room.		
Settlement Office.		**feet. feet.**
2 Rooms	... ...	... 20 by 20
1 Do.	... ...	... 16 ,, 20
1 Bath-room.		
Customs Office.		**feet. feet.**
1 Room	... ...	... 20 by 20
1 Do.	... ...	... 16 ,, 20
1 Bath-room.		
Treasury Office.		**feet. feet.**
1 Room	... ...	... 16 by 16
2 Do.	... ...	... 20 ,, 20
1 Bath-room.		
Duftar Hazuri.		**feet. feet.**
1 Room	... ...	... 16 by 20
1 Do.	... ...	... 20 ,, 20
1 Bath-room.		
Duftar Dasturi.		**feet. feet.**
1 Room	... ...	... 16 by 20
Piyad Bukhshi.		**feet. feet.**
1 Room	... ...	... 20 by 20
1 Do.	... ...	... 16 ,, 20
Mahkma Zabti.		**feet. feet.**
1 Room	... ...	... 20 by 20
Stamp Office.		**feet. feet,**
1 Room	... ...	... 10 by 16
1 Do.	... ...	... 16 ,, 20
1 Bath-room.		
Hawala.		**feet. feet.**
2 Rooms	... ...	... 20 by 20
1 Bath-room.		
Geerai Office.		**feet. feet.**
2 Rooms	... ...	... 20 by 20
1 Bath-room.		
Salt Department.		**feet. feet.**
1 Room	... ...	... 20 by 20
1 Do.	... ...	... 16 ,, 10
1 Bath-room.		
Munsiff's Court.		**feet. feet.**
1 Room	... ...	... 16 by 20
1 Do.	... ...	... 16 ,, 10
Court of Wards.		**feet. feet.**
2 Rooms	... ...	... 16 by 20

The dimensions given are, of course, only intended as a general guide to the amount of space wanted, they are not expected to be rigidly adhered to.

6. The work may cost up to about 3½ lacs of rupees.

7. Drawings and estimates should reach the office of the Manager, Jodhpore Railway, at Jodhpur, by the 15th of September.

8. As advertised, Rs. 1,000 will be paid to the author whose design is selected.

Jodhpore; *May* 14.

(Sd.) W. HOME,
Manager, Jodhpore Railway.

Schedule of Accommodation.

Index No.	Schedule of Accommodation.	Accommodation as required.	Accommodation provided.	In which building or Block located.
	Prime Minister's Court.	feet. feet	feet. feet.	
1	Musahib Ala's Kutchery ...	40 × 30	42 × 30	A.
2	Room for Clerks ..	16 ,, 10	20 ,, 10	,,
3	Room	30 ,, 20	30 ,, 20	,,
4	Secretary's Office ...	20 ,, 30	30 ,, 20	,,
5	1 Bath-room	...	10 ,, 8	,,
	Commander-in-Chief and M. P. Office.			
6-7	2 Rooms	30 ,, 20	30 ,, 20	A.
8	1 Do.	20 ,, 20	30 ,, 20	,,
9	1 Bath-Room	...	10 ,, 6	,,
	Diwan's Office.			
10-11	2 Rooms	20 ,, 20	30 ,, 20	,,
12	1 Bath-room	...	10½ ,, 8½	,,
	Appellate Court.			
13-14	2 Rooms	20 ,, 20	20 ,, 20	North Block B. upstairs.
15	1 Bath-room	...	10½ ,, 6½	
	Court of Sirdaran.			
16-17	2 Rooms	20 ,, 20	20 ,, 20& 30 ,, 16	South Block B. upstairs.
18	1 Do.	25 ,, 20	40 ,, 20	
19	1 Do.	16 ,, 20	16 ,, 20	
20	1 Bath-room	...	10 ,, 6	
	Civil Court.			
21	1 Room	20 ,, 20	20 ,, 20	North Block B.
22	1 Do.	16 ,, 20	20 ,, 20	
23	1 Do.	16 ,, 20	20 ,, 20	
24	1 Bath-room	...	10 ,, 6	
	Foujdari Court.			
25	1 Room	20 ,, 20	20 ,, 20	South Block B.
26	1 Do.	16 ,, 20	20 ,, 16	
27	1 Do.	20 ,, 20	20 ,, 20	
28	1 Bath-room	..	10 ,, 6	
	Mahkma Tamil.			
29	1 Room	20 ,, 20	30 ,, 20	A.
	Mahkma Bakiyat.			
30	1 Room	20 ,, 20	30 ,, 20	A.
	Foreign Secretary's Office.			
31	1 Room	20 ,, 20	30 ,, 20	A.
32	1 Verandah	15 ,, 10	72 ,, 10	
33	1 Bath-room	...	10 ,, 8	
	Settlement Office.			
34-35	2 Rooms	20 ,, 20	20 ,, 20	C.
36	1 Do.	16 ,, 20	20 ,, 16	
37	1 Bath-room	...	10 ,, 6	
	Customs Office.			
38	1 Room	20 ,, 20	20 ,, 20	D.
39	1 Do.	16 ,, 20	20 ,, 16	
40	1 Bath-room	...	12 ,, 10	
	Treasury Office.			
41	1 Room	16 ,, 16	20 ,, 17	D.
42-43	2 Do.	20 ,, 20	20 ,, 20	
44	1 Bath-room	...	10 ,, 6	
	Duftar Hazuri.			
45	1 Room	16 ,, 20	20 ,, 17	D.
46	1 Do.	20 ,, 20	20 ,, 20	
47	1 Bath-room	...	10 ,, 6	
	Duftar Dasturi.			
48	1 Room	16 ,, 20	20 ,, 16	C.
	Piyad Bukhshi.			
49	1 Room	20 ,, 20	21¾ ,, 20	D.
50	1 Do.	16 ,, 20	22 ,, 20	
	Mahkma Zabti.			
51	1 Room	20 ,, 20	30 ,, 20	A.
	Stamp Office.			
52	1 Room	10 ,, 16	17 ,, 10	D.
53	1 Do.	16 ,, 20	20 ,, 17	
54	1 Bath-room	...	10 ,, 8	
	Hawala.			
55-56	2 Rooms	20 ,, 20	20 ,, 20	C.
57	1 Bath-room	...	10 ,, 6	
	Salt Department.			
58	1 Room	20 ,, 20	20 ,, 20	C.
59	1 Do.	16 ,, 20	20 ,, 10	
60	1 Bath-room	...	10 ,, [illegible]	
	Geerai Office.			
61-62	2 Rooms	20 ,, 20	20 ,, 20	C.
63	1 Bath-room	...	10 ,, 6	
	Munsiff's Court.			
64	1 Room	16 ,, 20	20 ,, 16	C.
65	1 Do.	16 ,, 10	16 ,, 10	
	Court of Wards.			
66-67	2 Rooms	16 ,, 20	20 ,, 16& 20 ,, 20	North B.

S. S. JACOB, Lt.Col.

THE GEOMETRY OF THE OBLIQUE ARCH.

By A. Ewbank.

I.

The study of the oblique arch is not merely a matter of pure theory. Cases frequently arise when the common arch which has its face at right angles to the roadway that it crosses is not suitable to the conditions of the locality where an arch is needed.

Engineers begin their studies with a certain amount of what is called pure mathematics and what is called applied mathematics. But often their work chiefly consists in the application of formulæ to numerical cases and they have little practice in the manipulation of a number of algebraical symbols each of which has its numerial value hidden, so to say, for the time. The present discussion is accordingly addressed to those who are able to follow the steps of a mathematical argument although from want of practice coupled with want of leisure they could hardly originate the demonstration themselves or supply gaps in the reasoning if the proof was too slightly outlined.

The phrase applied mathematics sometimes seems to suggest that pure mathematics are first studied and then applied to practice. But frequently it is through the study of some practical difficulty in construction that theorems of pure mathematics are suggested. Of this indebtedness of pure mathematics the present paper will furnish an illustration.

We commence by some simple remarks on the geometry of a common arch. Such an arch we shall suppose to be a portion of a true circle.

duced pass strictly through one point in the plane of the face, *viz.*, through the centre of A E B. If in the intrados we follow one coursing line such as that which passes through G, we can through this coursing line draw a plane which will contain G H and all lines parallel to G H, each face of an elementary arch having one such line, or we may say that the line G H keeping its length and direction constant moves parallel to the line K M and so traces out a *plane*. This plane might itself be called a joint. But to avoid ambiguity, we shall not use the word joint. The plane through G H and the series of equal and parallel lines we shall call a coursing plane. The line G H we shall call a face coursing line.

If we suppose the roadway excavated and an inverted arch built we get a complete tunnel. We may suppose this tunnel of indefinite length and then *fig.* 1 may be said to denote a hollow cylinder having A B for internal diameter and C D for external. The line through O R parallel to K M is the common axis of the inner and outer cylinders. The coursing planes all round the complete tunnel all contain the line O R which is their common intersection. The common arch is a slice of this cylinder, having its faces at right angles to the axis. The oblique arch is a slice having its faces parallel to each other and inclined to the axis at some angle θ. As the cylinder may be supposed made of a number of common arches side by side, and the oblique arch then obtained by cutting a slice obliquely; we see that the coursing planes and lines might be the same as for the common arch. But it is needless to remark that oblique arches are never built after this fashion. In an oblique arch cut out of a group of common arches there would

Fig. 1.

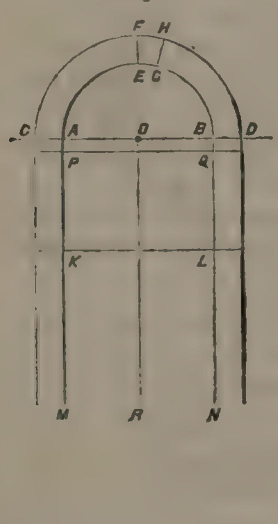
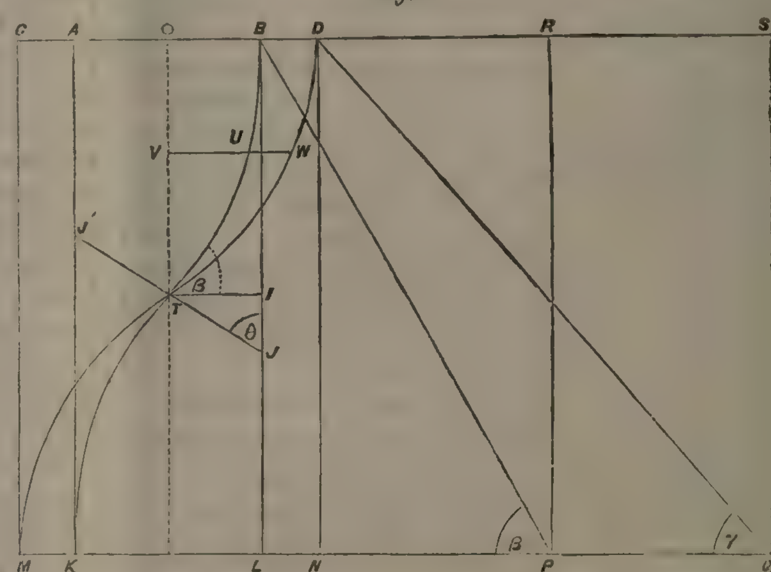


Fig. 2.



This common arch we shall suppose to be built of stone. If each block of stone is small enough we may consider them all of the same size and rectangular, the mortar dressing supplying the necessary modification in shape to suit them for their places in the arch. In *fig.* 1 the roadway is indicated by the lines K M L N. The arch in elevation is given by two semicircles A E B, C F D, neglecting constructive details. The width of the arch is A K or B L. If the dimension A K is large compared with the dimensions of the blocks of stone, we may consider the actual arch to be made by building side by side a number of arches each having its elevation given by the semi-circles A E B, C F D. When these elementary arches, so to say, of which A P is the breadth are built up side by side the joints of the courses on the inner surface or intrados will be straight lines parallel to K M. We will call these the intrados or inner coursing lines. The joints in the face of the complete arch or in the face of any elementary arch (the width of which elementary arch is determined by the dimension of the individual stones) will be straight lines such as E F, G H. These lines if pro-

be fractions of the stone blocks at the faces and whole stones only in the interior.

In *fig.* 2 A L is the plan of the inner surface of the hollow cylinder and C N the plan of the outer. On the inner surface is traced a spiral line denoted in plan by B T K. In a length 2 B L of the cylinder the spiral or screw would make one complete turn. B R is $\frac{\pi}{2} \times$ A B. Let the rectangle B P revolve about B L till it stands vertically up from the plane of the paper which is supposed horizontal. If it continues to revolve it will wrap itself round the surface of the cylinder A L. The line R P will finally coincide with A K because B R is equal to a semi-circumference. Let the plane, thus wrapping itself round, take upon it the impression of the curved line B T K. Then if this area B P is again unwrapped and laid over in its original position as in the figure, the impression of the spiral will become the straight line B P. The angle B P N is the constant pitch of the spiral or screw line. We will denote it by β.

In like manner, if a spiral line D T M on the outer

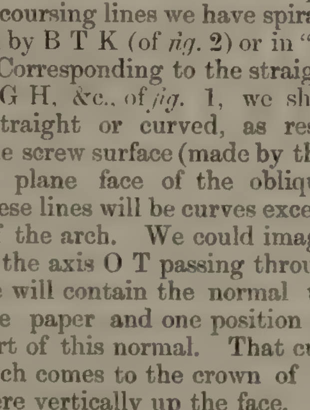
surface of the hollow cylinder makes a complete turn in the *same* length of the cylinder as does B T K, the plane area D Q being wrapped on the outer cylinder whose diameter is C D will ultimately have in the straight line D Q the impression of the spiral D T M. The area B P is called the development of the semi-cylindrical surface whose plane is A L. Similarly, D Q is the development of the semi-cylindrical surface shewn in plan by C N.

The two spirals are related curves. Through any point V on the axis O T draw a plane parallel to A E B of *fig.* 1. That is, draw a plane section normal to the axis. This will meet the spiral B T in a point whose projection is U. If VU be produced it will meet the outer spiral in a point shown in plan by W. Over the point T the line corresponding to U W is vertical. Its length is always equal to B D, the thickness of the hollow cylinder. This line U W (starting from the position B D and moving along the inner spiral so as always to be at right angles to the axis (and always so directed that it would if produced meet this axis,) makes on the inner cylinder a male screw thread of finite height, but without thickness. The pitch of the outer screw line is shown by the line D Q. This pitch is the angle γ which is not equal to β. A screw *line* has a definite pitch. A screw thread of finite height—that is a screw of any practical use—has different pitches for its inner and outer lines.

Now in *fig.* 1 we found that between the stones of the arch there were coursing planes all passing through the axis. In the oblique arch there are no coursing *planes.* The plane has changed to that screw surface which is generated by the motion of U W. Corresponding to the straight intrados coursing lines we have spiral lines such as is shown in plan by B T K (of *fig.* 2) or in "development" by the line B P. Corresponding to the straight face—coursing—lines E F, G H, &c., of *fig.* 1, we shall have such lines, whether straight or curved, as result from the intersection of the screw surface (made by the moving line U W) with the plane face of the oblique arch. As a matter of fact, these lines will be curves except in one case, *viz.* at the top of the arch. We could imagine a vertical plane oblique to the axis O T passing through the point T. Such a plane will contain the normal through T to the plane of the paper and one position of the moving line O W is a part of this normal. That curved intrados coursing line which comes to the crown of the arch will then run as it were vertically up the face.

Thus we now *assume* for the intrados coursing lines a series of spiral lines having the same pitch and at equal distances in the surface of the inside of the arch or the intrados. But we have not settled whether there should be any relation between the pitch (β) of these intrados coursing lines and the angle θ which gives the obliquity of the arch face. This point we will for the present leave unsettled.

Fig. 3.



Thus in *fig.* 3, let A M be the projection of the semicircular arch face. A M B = θ. Let BR = $\frac{\pi}{2} \times$ A B, then if we join M R we get an angle B M R whose tangent = $\frac{\pi}{2} \times \tan\theta$. An intrados coursing line is shewn by its development M N and the magnitude of the angle R M N is left at present undetermined. The face of the arch cuts the inner cylinder surface in an ellipse whose minor axis is the diameter of the cylinder and major axis the line A M. The upper half of this ellipse if developed would be a wavy line between M and R. The line M R itself would be the development of a spiral line which starting from M has made half a complete turn at As This spiral is not a plane curve whereas the ellipse is. Thu. the straight line M R is not the development of the semi-ellipse.

In *fig* 1 the intrados coursing lines are perpendicular to the face coursing lines. In, fact the first part of the line G H starting from G and the first part of the intrados coursing line that starts from G may be considered as edges of one of the stone blocks and the blocks are rectangular. But whether in the oblique face we can have the face coursing lines perpendicular to the intrados coursing lines is a point that requires examination. In *fig* 1 the intrados coursing lines are normal to the arch face and so to any line in the face. But whether this is always or even sometimes true of the oblique arch is another point to be examined.

In *fig* 1 the curve A E B—the semi-circle—may be considered a particular case of a spiral. In this case the constant pitch is zero. The term spiral implies that the curve is not *closed*—or not re-entering. Hence by the pitch becoming zero the non-closure is lost or the curve ceases to be truly spiral. But a small part of the arc of A E B would differ slightly in appearance from a small part of a spiral whose pitch was 1°. Similarly, the intrados coursing lines for the common arch are spirals. They are spirals whose pitch is 90°. They have continued to be non-closed curves, but they have lost that other property implied by the term "spiral"—the property of *twisting* round the cylinder. However, a small part of one of these coursing lines would differ little in appearance from a small part of a true spiral whose pitch was 89°. Thus in the common arch we may say that the curved arch line is a particular spiral, while the intrados coursing lines are other particular spirals. Moreover, these latter are perpendicular to the former, *i.e.*, to the arch line spiral A E B. As the intrados coursing line through G and the face coursing line G H are in direction two edges of a block of stone, so the line G E if its length is very small is the third edge of that block. Thus the blocks being cubes—or other rectangular bodies—we naturally have the intrados coursing lines perpendicular to the line G H and the arc G E at G and so perpendicular to the plane through G H and the arc at G, *i.e.*, perpendicular to the face of the arch. Hence continuing to use rectangular blocks for the oblique arch we naturally are led to inquire whether the intrados coursing lines could be so arranged as to meet the oblique face of the arch at right angles.

Moreover, we naturally endeavour to form for the construction of the oblique arch such rules that they shall give, as a particular case, the rules for the common arch. Now, in the common arch the intrados coursing lines are normal to the arch face. Therefore, let us *assume* that one at least of the oblique arch intrados lines shall be normal to the oblique face. And we continue to *assume* that these intrados lines shall be spirals, because as we have seen the straight intrados lines for the common arch may be called particular spirals. Another reason for taking spirals for the intrados lines is that the spiral is a tolerably simple curve. It "developes" into a straight line, as B P in *fig.* 2, and we can therefore easily arrange a family of spirals having the same pitch and equally spaced apart to suit the fact that our stones are of equal size.

(To be continued.)

A PEEP INTO THE BENGAL COAL FIELDS.

(From our Special Correspondent).

It is declared that the opening of the Bengal-Nagpore Railway will benefit many interested in coal and other articles of economical and commercial value. The alignment of the line passes through lands rich in mineral deposits, timber, oil-seeds, &c., and the completion and working of it will, it is believed, give impetus to the trade in these articles and tend to improve the coal and other industries of the part of the country tapped by the Railway.

The coal companies, of all others, likely to be most benefitted by the construction of this line, are the Bengal and the Equitable, who possess valuable mineral properties in the neighbourhood of it. The latter Company own large tracts of coal, iron, and lime stone lands not far from Barakar, and every effort is now being made by them through the local management to rapidly push forward the work of development and extension against the completion and working of the Bengal-Nagpore Railway, which actually traverses the property of the Company. With the present working and prospective enlargement of the field of operation, a good future may be said to be awaiting the prospects of the Company which is just emerging from the sea of misfortunes which attended its operations last year.

The Bengal Coal Company will not be slow in recognising the importance of the facilities afforded by the Bengal-Nagpore Railway, as they were in the choice of a splendid field of coal adjoining their property at Sanktoria, which has now passed into other hands, and will bestir themselves and order the exploration of their property along or in the neighbourhood of the line. This Company is doing well under the present able management and promises to outstrip past performances. Their works on the other side of Barakar river will be considerably aided and advanced by the proposed extension of the E. I. Railway to a point 5 miles beyond the present terminus. The cost of this undertaking, which will also include a bridge about half a mile long, is put down roughly at 20 lakhs of rupees.

The Barakar Coal Association's operations at Koomardoobi, I am told, are gradually but surely coming to a close, but with the aid of their energetic and careful manager they will soon find "fields fresh and pastures new," and thereby maintain the satisfactory results of the past several years which have characterised the management of the concern.

The Alipore Coal Co., also under the same management, is beginning to make a better show in the output of coal, and it is believed it will soon be in a position to declare large dividends.

The New Beerbhoom has attained a most commanding position in the mineral outturn of the district. Years ago the quantity as well as the profit were uncertain, fluctuating and unsatisfactory, but since the inauguration of improvements, surface and underground, in the transport of the mineral and economical and efficient administration, by the present management, the workings of the Company have grown into importance from comparative insignificance. The output is put down as 15,000 tons a month as against 8,000 in previous years and the dividends of the past two half-years do credit to the management which is as efficient as could be desired. This Company possesses an excellent property in Barria, which singly contributes 7,000 tons monthly to the output of the whole concern. Barring the mammoth seam and its mammoth returns it is questionable whether there is another individual colliery in Bengal, which does not include Chota Nagpore giving such results as the colliery just named. The Ranigunge Coal Association is once more, Phœnix-like rising from its ashes into existence. Its gropings through the darkness which had attended its financial aspects for many years has at length brought it out in the light of "silvery day," by the contraction of an 8 per cent. debenture loan, the shares whereof are now selling at a premium. Debentures are ominously held by some to be deadly debts, but in this instance I am told circumstances differ and the future is full of promise.

The Apcar's Collieries are under the managment of their Licensee, who has under most trying circumstances succeeded in showing good results during the last two years of his lease. The appeal touchiug the question of his sole Licen se is still undecided, but it will not be long before it is finally disposed of.

The Bengal, or rather Government Iron Works, turned out over 700 tons of pig-iron during last month, and it is hoped that the full quantity, *viz.* 25 tons a day will yet be obtained from each furnace. There are two furnaces of which only one is in blast. In anticipation it is reported the Government of India have wired for the contract of the whole of sleepers required for the Bengal-Nagpore Railway. If this is true, the conduct of the Governmet is reprehensible, as this is another instance of interference with private enterprise. Should, however, the Government Iron Works obtain the order, the whole of their stock of pig-iron would be used up and it will be necessary to light the other furnace, without which difficulty woul d be experienced in meeting the order in time. The Superintendent of these Works, I am told, has succeeded in solving the question of a cheap and effective plough for the country, and the pattern he has adopted and introduced is said to defy competition, though it may be susceptible to improvements There is a large and growing demand for the Bengal Iron Works ploughs.

The Native colliery proprietaries—of which there is legion—are doing as best they can under the present circumstances of high rates of royalty and rent and long leads. The decline which has just dawned on the coal trade and the expected further decline which will, it is supposed, set in when the Bengal-Nagpore Railway will have been completed and the additional mines in course of development and extension, render the profitable working of their collieries impossible, and some of these are in anticipation endeavouring to dispose of their royalty holdings. Another factor which will act negatively against the interest of these native owners is the high royalty and rent they are called upon to pay for their holdings by the zemindar. I am of opinion that the Maharanee Sarnomoyee is ill advised in imposing such high rates of royalties and rents for her mineral lands. High royalties will lead to high cost and this to restricted sales and therefore small returns to both the lessor and the lessee, the reverse of these conditions will lead to the realisation of better results and the influx of more elastic capital than is now the case. The incidence of the royalty and rent on the cost of coal is stated to be nearly one rupee! This is unquestionably too high and under no circumstance should it exceed a mean of annas eight per ton.

The complaint is general that there is scarcity of mining labour in the district arising from the fact of the drag upon it from Assam and elsewhere and the increase of collieries in the district which has redistributed labour.

As I write ne ws is brought to me of cholera having broken out at Barakar, causing much mischief.

Messrs. Gladstone, Wyllie and Co. have entered into the coal field as mining masters and intend in future to supply their requirements, which is put at about 80,000 maunds, a month, from their *own* collieries!

M. E.

Notes from the Far East.—A traveller from Anhwei reports that extensive coal mines exist in the mountains of that province, and the coal, which has been dug up by the natives there, proves to be fit for the use of steamers. It is expected to be worth while to work these mines with foreign machinery.

The *Courier d'Haiphong* says that Tonquin has been traversed by Engineers who are examining the country with a view to the construction of railways.

It is stated that the Viceroy of Chihli has addressed a letter to the Grand Council at Peking urging the construction of railways, and that Prince Ch'un and the officers of the Privy Council have presented a memorial to the Throne on the subject. It is further said that a scheme has been drawn up, the construction of the railway to be entrusted to a foreign firm, and a decree in acquiescence will soon be promulgated. *Nous verrons!*

The Chinese Government is evidently becoming more liberal in its ideas, as the prohibition on the export by sea of iron and steel from the provinces of Kwangtung and Kwangsi has been removed. The reason given is that the Viceroy considers the removal of these restrictions will enable the country metals to compete with those imported from foreign countries, and thus encourage mining enterprise.

The several reports of the Hong-Kong public companies lately issued show that the Ice Co. will declare a dividend at the rate of 12 per cent., the Bakery Co. have declared a dividend of 10 per cent., and the Dock Co. will declare a dividend of 7 per cent. for the past half-year.

NOTES FROM HOME.

(*From our own Correspondent.*)

The annual dinner of the Institution of Civil Engineers took place on the 30th ultimo at the Hotel Metropole, one of the largest and most sumptuously fitted of our modern hotels. The chair was occupied by Mr. Woods, the President, and the Colonies were represented by the Chief Secretary for Victoria, the Premiers of South Australia and of Queensland. Mr. Mundella, in proposing the toast of the "Institution," condemned the system of Government manufacturing departments as wasteful and extravagant and urged the employment of private firms. Lord Thurlow responded for the House of Lords and Mr. Courtenay for the House of Commons.

In a paper read before the Society of Civil and Mechanical Engineers on the Panama Canal, the author, who had visited the works, spoke of the sickness of the locality and the great mortality among the Europeans on the works. Reference was also made to the reckless waste of plant, the extravagance of the administration, and the consequent immense expense of the works. It was estimated that at the rate of progress made up to the present time the Canal would not be finished for another ten years. Besides the difficulties presented by the huge cuttings in the solid rock, there was also the difference of range of tide, which at one end is about double what it is at the other end of the Canal, a feature which must necessarily entail the construction of additional works.

The Institution of Naval Architects has commenced its sessional sittings for the present year under the presidency of the Earl of Ravensworth. In his opening address he dwelt on the remarkable development of steam navigation during recent years—the extraordinary improvement in the quality of ocean steam ships which had resulted from the introduction of triple expansion engines and the more general use of steam. Reference was made to the new metal aluminium as a new rival to steel, valuable as an alloy, producing a compound metal free from corrosion and one which was likely to revolutionize naval architecture.

Following the above, a paper was read by Sir Nathaniel Barnaby on the Merchant Service and the Royal Navy, in which the question of utilizing our fast merchant ships for war purposes was dealt with and advocated. At the same time the author recommended the post of a Secretary of State for the Navy, who should recognise the Mercantile Marine as forming part of the naval defences of the country, as the author feared that the present Board of Admiralty would never deal with the question fully and fairly. The Institution held their annual dinner on the same day at the Holborn Restaurant, on which occasion Lord G. Hamilton, First Lord of the Admiralty, responded to "The Army and Navy." The Institution has been invited to Sunderland for its meeting towards the end of the year.

In reference to the subject of a paper mentioned above, it may be observed that the Cunard Company receive over £17,000 a year from the Government, and if the Postal Contract be discontinued the Admiralty pay them £22,000 a year supplying them with fittings and bearing all cost of equipment. These figures represent the peace establishment; in case of war increased emoluments would be given them, the Government in such case assuming all risks or damage.

The Newcastle Exhibition is to be opened on the 11th of May by the Duke of Cambridge, and from the efforts that are being made, it promises to be a successful show. The North of England Institution of Mining and Mechanical Engineers together with the influence of Elswick, are bent upon making the occasion as instructive as possible.

Amongst other things, there is to be a coupling contest at Newcastle for the championship. The object is to test expedition in the use of the coupling pole, an ashpole 5 feet 9 inches long with a hook attached to the end of it for coupling and uncoupling. The use of this is strongly advocated in the absence of mechanical contrivances, to supersede the dangerous practice of men getting under the buffers while the waggons are in motion, which has been the means of losing many valuable lives.

An automatic self-acting switch joint for Tramways has recently been invented by a Mr. Cowan of Newcastle. It consists of the addition of a spring to the present form of moveable joints, thereby always preventing the car from taking the wrong line on single lines at passing places, and it has the additional advantage of avoiding any exertion on the part of the horses to keep on the proper line.

In the *Engineer* particulars are given of the Metropolitan Railway, which though not exactly a new work is of considerable interest. People will read with considerable interest the details of the magazine rifle with which Germany has been recently arming her warriors.

Printing Machinery is the title of the paper to be read at the next meeting of the Institution of Civil Engineers.

MINING IN GREAT BRITAIN.

(*From our own Correspondent.*)

The number of explosives has largely increased of late years. One of the most recent inventions being bellite. It has been introduced by Mr. Karl Lamm, of Stockholm, and is a mixture of dinitro benzine or trinitro benzine with nitrate of ammonia. It is weight for weight more powerful than guncotton, and 3½ times more powerful than blasting powder. It cannot be ignited by intense heat or flame, and being unaffected by blows, its carriage and transport can be safely conducted.

Attention has recently been directed in England to the importance of stowing the goaves in coal mines, owing to the numerous advantages the system is said to possess. The system is extensively carried out on the continent, and year by year, it is becoming more general. The material for the stowing is derived from quarries in the mines, or where that is impossible or difficult, it is procured from the surface. The importance of the question is being considered in Westphalia, and prizes are being offered for the best papers (written in German) upon the application of the system and its advantages in coal mines.

Whilst endeavouring to secure an efficient light, which shall be safe even in explosive mixtures of fire damp and air, inventors of electric safety lamps appear at all times to have overlooked the necessity of attaching to each lamp some form of automatic apparatus to shew the presence of dangerous gases. In the absence of such apparatus a miner may remain at work and be suffocated by fire damp or carbonic acid gas. Inventors should, therefore, turn their attention to some automatic arrangement, not requiring especial or constant attention, but which would at all times show the miner whether he was working in a dangerous atmosphere. A safe lamp should give a good light and at the same time warn the miner as to the presence of gas.

Endless rope haulage is becoming more generally used in mines: one of its most recent applications being at Newbattle collieries near Edinburgh. The tubs are drawn up an incline 400 yards long, dipping 2 in 3. Two (4-inch circumference) patent steel galvanised endless ropes are applied to each tub, by means of yokes or jiggers, one of which is placed on each side of the tubs. The dead weight on the pair of ropes will be about 7 tons. The daily amount drawn up this bank is about 500 tons.

In connection with the frequent discussions upon the dangers of coal dusts in mines, it is alleged that "dant" or "mother of coal" is more dangerous than coal itself when in the form of dust. The analysis by Dr. P. P. Bedson, of the Durham College of Science, shews that so far as the constituents are concerned, that the contention is not sustained.

The use of sugar has been recommended for preventing incrustations in steam boilers. It would appear from the experiments of Messrs. Klein and Berg that the sugar introduced for this purpose corrodes and destroys the plates. They found that the sugar produced a solution acting like a feeble acid. The dissolved iron in the form of peroxide of iron varied from one-eighth to one-fifth of the weight of sugar introduced.

The subject of safety lamps must always be of the greatest interest to those concerned in mines, and it is very appropriate that the Newcastle-upon-Tyne Mining, Engineering, and Industrial Exhibition should pay marked attention to this section. Arrangements are being made for the exhibition of as many lamps as possible, and although the addresses of inventors are not in every case known, it is hoped that they will communicate with the Secretary and arrange to have their inventions shown at the Exhibition. A small charge will be made for the accommodation, and lamps accompanied with concise descriptions should be received at the Exhibition early April (current).

THE MADRAS HARBOUR.

Its Construction, Destruction and Reconstruction.

VIII.

Mr. Molesworth, in his report on the effects of the storm of 12th November 1881 on the harbour works, goes fully into the nature of the storm, and gives a diagram of its probable path from the east-south-eastward to the coast south of Madras, from which he shows that such a course as that cyclone might reasonably be expected to take is the most trying that could be taken as regards the harbour works of Madras, because passing to the southward it would tend to heap up the ground swell, whereas a cyclone passing to the northward of Madras would to a certain extent neutralise it. He, too, quotes Mr. Chisholm, whose past experience in harbour engineering, he said, qualified him to express an opinion. " On both these occasions he had an opportunity of carefully examining the waves, and he has expressed a decided conviction that the waves in the storm of November 12th 1881 were far more formidable than those of the cyclone which passed over Madras in 1872." He, Mr. Molesworth, dwells on this point, " in order to combat the popular idea that the storm which wrecked the Madras harbour works was altogether insignificant in its character." It may be observed that in the circumstances, Mr. Molesworth's inclination, in the face of the bulk of the evidence, to think that the sea of 12th November 1881, was a very heavy one was harmless ; but, had the works withstood the storm, and the question been whether they had been fully tested, and consequently did not require to be strengthened, such a conclusion might have had most disastrous results, in the event of it proving to be unfounded. But it is fair to show what Mr. Molesworth thought of the sea. Lieutenant Stiffe, too, says that the sea, originating on the advancing north side of the centre of the cyclone, and propelled by it on to the harbour works, was, there was no doubt, very high, and of destructive violence, and he, too, though a sailor, appears to have ranked the opinion of Mr. Chisholm, the Engineer, on this point, higher than that of the Madras nautical authorities.

Turning to Plate III., given with our last article, diagram No. 3 roughly indicates the state in which the work was found, the black portions being those which still showed above the level of the water, while the dotted lines show the parts which were under water. The entrance, Mr. Molesworth said, seemed to have suffered very little, by which he seems to have meant that it was very little obstructed by *débris ;* but it had been deepened, he said, slightly by a foot or two in places, owing to the violent ebb of the large volume of water thrown into the harbour. The quadrant block at the head of the north pier was for a few feet slightly undermined to a depth of 10 or 12 inches below its bottom ; but the scour, he says, " only extended horizontally for a few inches under the block, for, while standing upright, I could easily reach with my toe the end of the cavity ; on either side of this scour the rubble was piled up against the block 3 or 4 feet above its bottom. The rubble seemed to have been displaced, and I observed no signs of its having disintegrated under the wave action. The lower courses round the head were all there, and apparently undisturbed. The quadrant block on the west of the south pier was underscoured rather more than that of the north pier ; but the bottom block also appears to be undisturbed, as in the case of the north pier.

" No blocks have fallen outwards on the sea-side of the *faces* of the north and south piers, excepting at one place close to the junction of the face with the elbow of the south pier ; the bottom blocks and, in most cases, the course above them are in their original position ; some may possibly have been driven in slightly, but it is impossible to determine this point with any degree of accuracy for want of some fixed point of departure. The rubble base is in some cases piled up against the bottom block, whilst in others it is underscoured to the extent of 2 or 3 feet ; but in no case, except that to which I have referred above, have the *faces* failed from undermining. The failure appears to have been solely due to the displacement of the blocks by repeated blows of the waves. Where the pier has been widened in cross section to three or four blocks, the addition does not appear to have increased its strength, for the wider portions have suffered equally with those that only consist of two blocks in width. The outside slopes of the rubble base have, for the most part but not invariably, been pulled down to a flatter slope, and the wash of the sand at the toe of the slope has absorbed some of the rubble.

"The inner slopes of the rubble base appear to have been uninjured by the storm. The left hand section in Diagram No. 4 shows the general type of failure in the *face* wall.

" The right hand sections show the type of failure in the *elbows*, on which the wave action has been different from that on the *faces*, and the wreck has consequently been more complete. The waves reflected from the face have met the wave directly coming from the sea, and set up a huge confluent wave which closely hugs the elbow and follows round it, tearing up the rubble base and undermining the blocks to such an extent that the outer row of blocks of the *elbows* has, in nearly every case, fallen outwards, whilst the inner row have fallen into the harbour.

" The inner slope of rubble face, supporting the elbows has apparently been uninjured, as in the case of the base supporting the faces.

" In some instances, where the blocks were displaced by blows of the wave, they have been prevented from returning to their original position by the projecting tenons of the block below them ; this action is illustrated by the central figure in Diagram No. 4.

" There are several instances of the outer or sea row of blocks standing, while the inner or harbour row has been driven in by the blow of the waves, the rubble base inside the harbour being apparently sound.

" At some parts of the pier, which have been uninjured by the cyclone, a constant but slow rocking action of the vertical walls from the action of the swell goes on even in calm weather to the extent of about 1 inch, but the action can only be detected by closely watching the joint ; this action is probably severe in storms, for in some instances the joints of the blocks are ground into each other to a depth of some inches. I have observed a similar rocking action on a calm day on the Manora breakwater to Kurrachee."

The extent of the damage done to the works may be measured by the time and labour taken to ascertain it. Mr. Beardsmore, the Acting Superintendent, appears to have begun his survey as soon as the season permitted, but it was not until the middle of July 1882 that he was able to submit to Government the Drawings which we reproduce in Plate IV. Most of the work was done from catamarans. More sections then remained to be taken, and Mr. Beardsmore said that if favourable weather for taking them did not occur in September or October he would have to wait till February 1883.

The destructive action of the waves on a structure similar to that of the Madras Harbour face Mr. Molesworth analyses into—

1st.—The direct blow of the wave on the outer block.

2nd.—The percussive action communicated by one block to another.

3rd.—The compression of air in the joints.

4th.—The dragging action of the wave on the top block.

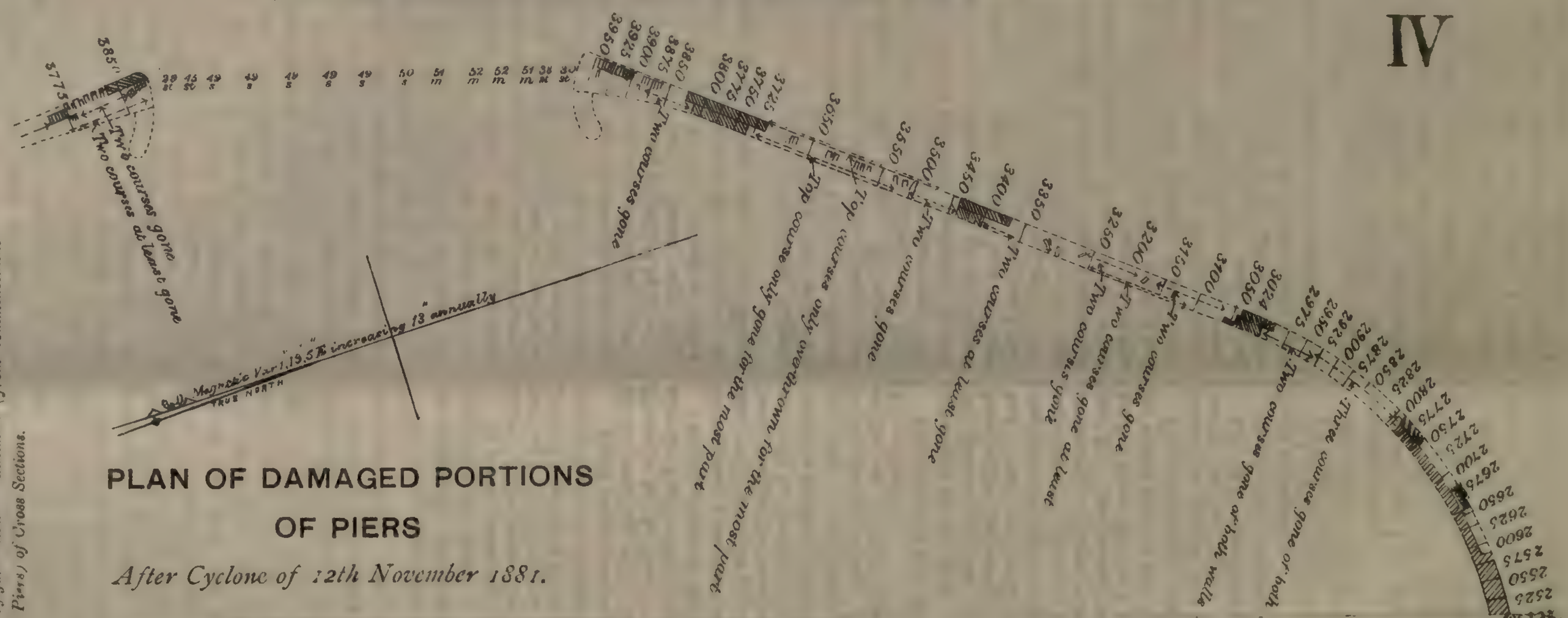
5th.—The vacuum formed behind the wall from the receding wave.

With regard to the *first* effect, Mr. Molesworth observes that it is most severe when received on a flat surface. The *second* effect, familiarly illustrated by a stroke communicated through a series of billiard balls, —and, we may add, through a series of bottle corks placed end to end,—he points out is denoted where the inner, or harbour, row of blocks was driven in, although the outer row stood, and even where the width

MADRAS HARBOUR WORKS.

IV

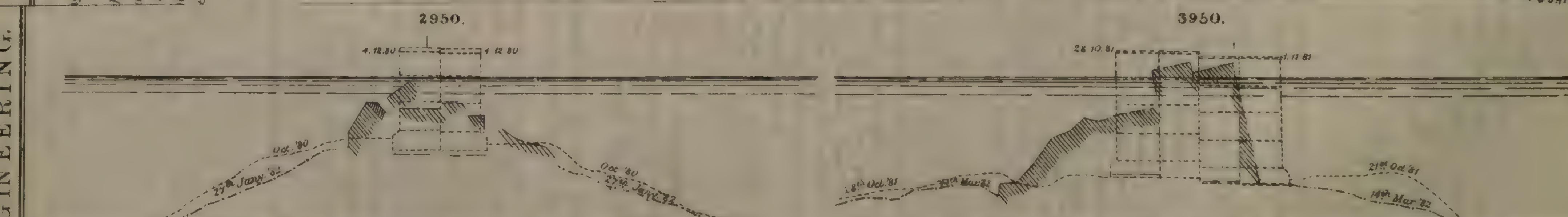
SCALE OF FEET



PLAN OF DAMAGED PORTIONS OF PIERS

After Cyclone of 12th November 1881.

g thus ///// shows intact portions of the Piers.
,, \\\\\ are Blocks lying flat.
hown thus are Blocks tilted & above Low Water
dings across Entrance were taken on 16th February
and are reduced to D., H. M. S. L.
ual figures show distances (from commencement
e Piers) of Cross Sections.



after the Titan and Engines had passed over it. The long dotted lines show the latest known levels of the Pier before the Cyclone and consequent damage in Nov. 1881.

The position of the Centre Line is a little uncertain in some cases.

The "Star" Press.

was increased to three or four blocks. *Third*, the blow of the waves compresses the small quantity of air between the joints which in its turn tends to compress the water in the joints. He says instances have frequently occurred of blocks of masonry starting out from the sea-face of a vertical wall after the blow of a breaking wave had compressed the air in the joints. *Fourth*. The dragging action of the wave on the top of the wall may have combined with the second and third manifestations to displace the blocks on the harbour side. *Fifth*. The vacuum formed by the receding wave must, Mr. Molesworth thinks, have contributed to the destruction, though in a minor degree. He says;—"The form of breakwater which has been adopted by Mr. Parkes is exposed to every action above described."

To these ways in which the waves, might take effect, a *sixth* may very obviously be added—though it is a result of the *first*. This was described by the present writer in one of a series of articles on the failure of the harbour, which were published in the *Englishman* newspaper in January 1882, thus:—

"This contrast between these profiles of the two structures,—the Portland breakwater and the Madras groynes,—is most marked. The first, above the depth at which waves begin to have effect, presents on the sea-face a gradually flattening beach, composed of loose irregularly shaped blocks of stone, which have been tipped into the sea and knocked about by it until they have assumed the natural angle of repose. Up this slope the waves rush and gradually spend themselves, and they are unchecked by wall or parapet of any kind; and when they cross the level crest they run down a moderate slope of the same material. The second, the Madras pattern, down to the level at which the gentle slope of the Portland work stops, because the waves there cease to take effect, is an absolutely vertical and smooth wall, against which the waves are invited to expend their full fury, just as they do on the side of a ship,—only that the wall, unlike the ship, is unyielding. The waves cannot pass under the wall, as they pass under the ship. Such a wall, at Colombo, seems to stand well, but there the width is 34 feet instead of 24 as at Madras, and the blocks of which it is built are most thoroughly bonded together. The 24 feet wall may, theoretically, be heavy enough to withstand the force of the waves, but everything is made to depend upon the accurate fitting together of the individual blocks, there being no cement in the joints, and no bond worth speaking of. It is not to be supposed that Mr. Parkes thinks that a single block of 27 tons weight is too heavy to be moved by the force of the sea, for at Wick a block 45 feet wide, and weighing 1,400 tons, was so moved. If therefore the lateral pressure and friction against each other of the blocks in the upper tier is imperfect, they become liable to be displaced by the diagonally upward lift, or send, of the waves, just as if a crowbar were applied underneath them. The next row of blocks will be a fulcrum on which the top inner corners of the outer blocks will work, and when the wave recedes these outer blocks will spring outwards, just as they would if prized out by a crowbar. At the next blow the blocks would much more easily turn on the lower inner corners, and then jump outwards as before. If one block were thus materially knocked out of its place the whole structure would be weakened, and the ruin would be rapid. Here, then, is one way in which such a pattern of breakwater as the Madras one might fail, even if the rubble base remained uninjured."

Mr. Molesworth attributes the fall outwards of the outer row of blocks at the elbows to the scour of the confluent wave which undermined them, but it is evident that directly any undermining or settlement below the outer row occurred, and the joint opened ever so little there would be room for no *sixth* form of wave action to come into play; and it would be set up also if the joint was opened by the third action—the compression of air.

(To be continued.)

BURMAH.

(From our own Correspondent.)

MINING.—The Murray Coal Company from Calcutta, after negotiating with the Chief Commissioner for several years, have finally succeeded in obtaining a 30 years' lease of working the coal tracts situate in the Thayetmyo district. The land containing the coal deposits is about 3½ square miles, and is reported to be rich in this mineral; but up to the present time, no profitable seam has been struck. As a condition of obtaining the concession, the Company have covenanted to pay a nominal rent on the land actually worked, and further to pay a royalty of 2 annas for every ton of coal extracted after 1st January 1885. The lease also contains further provisions, empowering the Chief Commissioner to cancel the lease, should the lessees fail to work the concessions within a certain period. A member of the Company is now prospecting, and is confident of discovering a seam which will yield a profitable outturn.

The earth oil industry at Akyab is now suspended, as the partners of the defunct Boronga Oil Company are individually claiming the rights of ownership; the matter is now *sub judice*—meanwhile those concerned in the undertaking are heavy losers, as it is believed some £20,000 worth of machinery and appliances have been sunk in the speculation.

CANALS.—The principal works which are now being carried out, are the Sittang and Kaikto canals, which will be about 14 miles long. Up to the present time, Rs. 50,670 has been spent, 5 miles of excavation have been completed to the full section of the canal, and 3 miles have been partly excavated; the bed of laterite which formed a bar, has now been removed and the work is progressing rapidly. Attention has also been directed in Mandalay to improving the irrigation of the Kyaukse and Salim streams. These canals are described to be very old and kept in order by former kings. It is now contemplated to drain the hollow country between the canals, strengthening and reducing the number of weirs and main canals, strengthening the banks of the larger channels and digging out the smaller, so as to render the larger canals thoroughly navigable, as well as to serve the purpose of irrigation to the surrounding country.

SURVEYS.—The Topographical survey party are now engaged in mapping the forest reserves of Pegu. During the year, 861 square miles were surveyed in the Tharrawaddy and Prome districts at an average cost of Rs. 1,14,700. The Cadastral Survey are now busy in Akyab, 661 square miles have been surveyed at a total cost of Rs. 1,78,890 or an average of about 8 annas per acre. A new system which has been found very successful was introduced by the Cadastral Survey (*i.e.*) in attaching camp-holding recorders from the Settlement Office to mark out errors and omissions in the traces made over to them by the Amins; this system avoids a revisional survey, and will be introduced in subsequent operations.

A novel experiment was exhibited before the public in Rangoon by Mr. Moncrieff, Agent of the Fairy Queen Fire Extincteur Company. A platform of timber was erected about 10 or 12 feet high, filled with shavings, &c., and saturated with oil, tar, &c., and the whole structure set ablaze, when Mr. Moncrieff directed his hose against it; and after a few squirts the fire was extinguished. The principal properties charged in the machine are alkali and sulphuric acid, the pressure to pump out the chemical being obtained by means of gas worked in at the other end. This system although successful is by no means an economic one, from the fact that chemicals have to be used instead of water.

The Municipality, however, intend to try a different mode, and for this purpose have purchased fireproof screens, which we trust will be more successful than their former attempts in controlling large fires which so frequently happen in this city.

April 21. H. T.

THE Brisbane Tramway Company are about to introduce electric power as a motor on their lines.

SIR WILLIAM ANDREW, the father of Indian Railways, is dead. He sketched out a comprehensive Railway policy for India in 1846, and was also one of the first promoters of telegraphic communication in the East.

CAPTAIN JAMES BUCHANAN EADS.—The death is announced of Captain James Buchanan Eads, the distinguished American Engineer, well-known by reputation through his construction of the St. Louis Bridge, his Mississippi works, and his proposed Tehuantepec Railway. He was born at Lawrenceburg, Indiana, on 23rd May 1820.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burmah, April 16, 1887.

Mr M. Birkbeck, Executive Engineer, 2nd grade, Henzada Division, is granted one year's leave on medical certificate, with effect from such date as he may be relieved of his duties.

With reference to *Burmah Gazette* Notification dated the 7th March 1887, Sirdar Bahadur Bhagat Singh, Executive Engineer, 3rd grade, sub. *pro tem.*, assumed charge of the Yaméthin Division, Upper Burmah, on the forenoon of the 18th March 1887.

Madras, April 19, 1887.

The following transfer is ordered :—

Colonel H. M. Vibart, R.E., Superintending Engineer, 1st class, temporary rank, from the III. Circle to the charge of the V. Circle. To join at the public expense.

The following postings are ordered :—

Mr. C. J. Peters, Executive Engineer, 1st grade, sub. *pro tem.*, from the Kurnool Division to the charge of the III. Circle. To join at the public expense.

Mr. G. P. Carless, Executive Engineer, 4th grade, temporary rank, to the charge of the Kurnool Division.

Furlough in India for two months, with effect from 8th May 1887, is granted to Mr. W. Hughes, B.A., Executive Engineer, 2nd grade, in extension of the leave granted to him in the *Gazette* of the 2nd March 1887.

The following promotion is made :—

Mr. C. J. Peters, Executive Engineer, 1st grade, sub. *pro tem.*, to be Superintending Engineer, 3rd class, with effect from date of Colonel W. H. Burton's departure on furlough, temporary rank.

The following transfer is ordered :—

Mr. C. A. B. Target, Executive Engineer, 1st grade, from the Nilgiri Division to the VI. Circle for charge of the Ramnad Division. To join at the public expense on Mr. W. B. DeWinton's return from privilege leave.

Bombay, April 21, 1887.

Rao Saheb Himutlal Dhirajram, Assistant Engineer, 1st grade, is appointed to act as Executive Engineer, Surat and Broach, during the absence of Mr. K. R. Godbole on privilege leave.

India, April 23, 1887.

Messrs. W. H. King, Executive Engineer, 2nd grade, and H. O. Walling, Assistant Engineer, 1st grade, Bengal, temporarily employed in Baluchistan, are transferred temporarily to Burmah for employment on Provincial Works.

Mr. E. H. Hallum, Executive Engineer, 3rd grade, State Railways, whose services have been lent to the Southern Mahratta Railway Company, is granted furlough for twenty months with the necessary subsidiary leave.

The services of Major H. H. Cole, R.E., Executive Engineer, 1st grade, Central India, are temporarily placed at the disposal of the Foreign Department, with effect from the 20th January 1887, the date on which he joined the Gwalior State.

The services of Mr. S. P. H. Dyson, Assistant Engineer, 1st grade, sub. *pro tem*, North-Western Provinces and Oudh, are placed at the disposal of the Home Department for employment on probation in Burmah.

Baluchistan.

Mr. W. H. Rushton, Assistant Engineer, 1st Division, Frontier Road, is granted two months' privilege leave, with effect from the 15th instant, or such subsequent date as he may avail himself of it.

Mr. W. B. Starky, Assistant Engineer, is transferred from the 2nd to the 1st Division, Frontier Road.

Railways.

Babu Baroda Prasad Basu, Executive Engineer, 4th grade, sub. *pro tem.*, is, on return from leave on medical certificate, granted him in the Government of Bengal, Public Works Department Notifications dated 7th March and 7th April 1887, posted to the Bellary-Kistna State Railway.

Mr. G. F. Thompson, Assistant Engineer, 2nd grade, is granted language leave for three months, with effect from such date as he may be permitted to avail himself of the same.

Punjab, April 14, 1887.

Mr. F. W. Maunsell, Assistant Engineer, 1st grade, 3rd Division, Sirhind Canal, passed the Departmental Standard Examination.

The one year's furlough granted to Mr. W. Smith, Executive Engineer, 4th grade, attached to the Chenab Canal Division, is cancelled at his own request.

N.-W. P. and Oudh, April 23, 1887.

Buildings and Roads Branch.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following promotions and reversions, with effect from the dates specified :—

Babu Sheo Nath, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, from 15th March 1887, consequent on the return of Mr. Henslowe from furlough.

Mr. S. J. Simpson, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, from 16th March 1887, sub. *pro tem*, *vice* Mr. Vernon, on leave without allowances.

Babu Sheo Nath, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, from 16th March 1887, sub. *pro tem.*, *vice* Mr. Vernon, on leave without allowances.

Babu Surján Das, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, from 16th March 1887 sub. *pro tem.*, *vice* Mr. Vernon, on leave without allowances.

Babu Sheo Nath, Executive Engineer, 4th grade, sub. *pro tem.*, to be Assistant Engineer, 1st grade, from 8th April 1887, consequent on the return of Mr. Heinig from furlough.

Irrigation Branch.

Babu Jogindro Nath Mukerji, Executive Engineer, 3rd grade, sub. *pro tem.*, Cawnpore Division, Lower Ganges Canal, is granted six months' leave on medical certificate, with effect from the date of his relief in the Railway Branch.

With reference to Government of India Notification, dated 11th April 1887, re-transferring him to these Provinces, Mr. E. W. S. Douglas, Executive Engineer, 3rd grade, is re-posted to the 2nd Circle, Irrigation Works.

Bengal, April 27, 1887.

Establishment.

Rai Sahib Krishna Chundra Bandopadhya, Assistant Engineer, 1st grade, rejoined the Patna Division on the 2nd instant on return from leave on medical certificate.

The undermentioned Assistant Engineers have passed the examination prescribed in Public Works Code, Chapter II., paragraph 10 (5th edition) :—

Mr. J. S. L. Long, Assistant Engineer, 2nd grade.
„ G. C. Stawell, ditto, ditto.
Baboo Annada Prosad Sircar, ditto, 3rd grade.

The following promotions and reversions are made in the Engineer Establishment with effect from the dates specified :—

Rai Madhub Chunder Roy Bahadur, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 1st January 1887.

Mr. F. Sills, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 8th February 1887.

Mr. J. A. Price, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 8th February 1887.

Mr T. M. L. Thompson, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 17th November 1886.

Mr. J. R. Swinden, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 1st January 1887.

Rai Madhub Chunder Roy Bahadur, Executive Engineer, 1st grade, sub, *pro tem.*, to revert to Executive Engineer, 2nd grade with effect from 1st April 1887.

Mr. F. Sills, Executive Engineer, 1st grade, sub. *pro tem.*, to revert to Executive Engineer, 2nd grade, with effect from 1st April 1887.

Mr. J. A. Price, Executive Engineer, 2nd grade, sub. *pro tem.*, to revert to Executive Engineer, 3rd grade, with effect from 1st April 1887.

Mr. C A. Mills, Executive Engineer, 2nd grade, sub. *pro tem.* to revert to Executive Engineer, 3rd grade, with effect from 1st April 1887.

Mr. J. D. Davies, Executive Engineer, 2nd grade, sub. *pro tem.*, to revert to Executive Engineer, 3rd grade, with effect from 1st April 1887.

Mr. J. R. Swinden, Executive Engineer, 3rd grade, sub. *pro tem.*, to revert to Executive Engineer, 4th grade, with effect from 1st April 1887.

Mr. H. Barlow, Assistant Engineer, is transferred in the interests of the public service from the Arrah to the Buxar Division, which he joined on the forenoon of the 5th instant.

Rai Sahib Annada Prosad Sarkar, Assistant Engineer, 3rd grade, Brahmini-Byturni Division, having passed the examination prescribed in Public Works Code, Chapter II., paragraph 10, on the 18th April 1887, is promoted to Assistant Engineer, 2nd grade, from that grade.

The Lieutenant-Governor is pleased to make the following promotions in the Engineer Establisment, with effect from the 18th April 1887 :—

Mr. J. S. L. Long, Assistant Engineer, 2nd grade, to be Assistant Engineer 1st grade, sub. *pro tem.*

Mr. G. C. Stawell, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, sub. *pro tem.*

Mr. C. P. Warde, Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, sub. *pro tem.*

Establishment—Railway.

Mr. C. Von Ahn, Executive Engineer, 3rd grade, Assam-Behar State Railway, is granted 13 months' furlough, with the necessary subsidiary leave, with effect from the 1st May 1887, or such date as he may be allowed to avail himself of the same.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

The 11th April 1887.

139 of '86.—Robert Bosse and Franz Wolters, of Brunswick, in the Empire of Germany.—*For an improved process for rendering cements hydraulic, that is to say, capable of setting and hardening under water.*

65 of '87.—Alfred Inderwick, of London, England, Solicitor.—*For an improved process of and apparatus for torrefying grain, cereals or seeds, to adapt them for use in brewing, distilling or vinegar-making, or in feeding horses, cattle, and live stock.*

The 18th April 1887.

214 of '86.—William Barclay Wishart, Gentleman, of Cawnpore, India.—*For a general utility tent.*

51 of '87.—The Westinghouse Brake Company, Limited, of Canal Road, Kings Cross, in the County of Middlesex, England.—*For improvements in connections for pipes on railway trains coupled from carriage to carriage.*

62 of '87.—Richard Olpherts, of Ardee, Ireland, Esquire.—*For improvements in obtaining colouring matters from the indigo plant.*

SELECTED ABSTRACTS OF RECENT INDIAN SPECIFICATIONS.

Cooling Water for Ice making Machinery.—9 (1887).—*John George Farthing*, Mechanical Engineer. Relates to the cooling of any kind of liquid, particularly water, by being cooled by a pan and receiver with a series of tubes with small holes in them placed transversely or obliquely or otherwise for allowing the water to spray on cus-cus, durmah, hoogla, cocoanut leaf or straw matting placed tranversely or obliquely or otherwise, so rendering it a powerful cooling apparatus. The mode of action is, the water being discharged from the pump of the Engine into the water receiver or tray, is then acted on by the pan driven by the vertical and horizontal shaft and by two level wheels, and fully driven by the main shafting off any Engine by belt at from 80 to 100 revolutions per minute ; the water then flows into a tray or receiver and then pours down through tubes out through small holes spraying the water on matting made of cuscus or other material placed transversely, obliquely or otherwise, and then through small holes in the bottom plate and then overflows into other water or other liquid or water condensing tank or receiver, to be pumped up and used over again.

Utilizing Solar Heat for raising Water.—128 (1886).—*Charles Tellier.* This invention relates to a method and apparatus for utilizing atmospheric or solar heat for raising water and other purposes, and it consists in arranging heating surfaces (forming a receiver adapted by preference to be placed on the roof of a building) so prepared, that they allow of collecting atmospheric or solar heat for gasifying a body which boils at a low temperature such as ammonia in solution, certain carburets of hydrogen, ethylamine and the like. At the same time the relative low temperature possessed by the water extracted is utilized so as to condense the vapours of the volatile bodies above named in order to bring them back either in a liquid state or in a state of solution into the receiver having large surfaces above described. The difference beween the tension of the vapours obtained by atmospheric heat and the much lower tension determined by the temperature of the water allows of this water rising from below the earth to the surface thereof.

In carrying this invention into effect, flat receivers are provided made of two plates of sheet metal forming air-tight vessels, in which the volatile body is enclosed and submitted to the action of atmospheric or solar heat. By means of a motor similar to a condensing Engine, or by means of a spherical apparatus enclosing a flexible membrane which acts sometimes on the upper and sometimes on the lower hemisphere and acted on by the fluid vaporized by the atmospheric heat, the water is forced from the soil so as to bring it to the surface. The action above described is continued and the movement sustained by the calorific afflux furnished by the atmosphere or the sun, and at the same time by the frigorific condensing action of the water rising from the earth.

Improvements in Rice hulling Machines.—191 (1886).—*Evaristo Conrado Engelberg.* Relates to improvements in rice hulling machines so designed as to make such machines more stable and regular in their working than heretofore and to increase their durability. According to this invention a piece of wood of the required shape is substituted for the stone or concrete block heretofore used, while the narrow surfaces thereof against which the rice is hulled are provided with iron plates at equal distance 0m·05, more or less apart, thus forming projections in front of which the cylinder revolves. On the lower surface of the block is fixed a steel bar or plate which is capable of adjustment towards or away from the hulling cylinder to the extent of 0m·004 more or less.

The block is sometimes composed of wood, one edge of which is formed of iron plates and stripes of wood placed alternately one above another, so that, they present a rough surface against which the rice is pressed and hulled principally by the friction caused by the accumulation of rice between the said block and the cylinder.

Both of these forms of blocks give excellent results with respect to duration and efficacy.

Improvements in Machinery for rolling tea leaves.—22 (1887).—*Willam Jackson.* This invention has for its object to provide means to obtain an elastic pressure on the leaf in rolling it and at the same time to enable that pressure to be controlled by means of the screw whilst retaining the rigidity of the parts by which the screw is carried.

The screw to which I refer is that which has hitherto been used simply for the purpose of drawing the rolling surfaces apart. The pressure upon the leaf having been applied to the upper rolling box by means of loose weights placed on the upper rolling plate or block.

According to this invention these weights are dispensed with and a spring substituted in their place. This spring is placed underneath the davit or bracket through which the screw passes. As the single davit hitherto used is not generally strong enough to apply the spring, the davit is therefore extended across to the other pillar, so making of it a bridge form arranged so as to be readily screwed when the pressure is put on and released when the upper plate or block is required to be swung aside.

Notices.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies, and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Obituary.

HENNESSEY—24th April, at St. Thomé, J. Hennessey, Superintendent, Technical Section, Madras D. P. W.

GIBBON.—On the 4th April, at his residence, Moorside, Bushey Heath, Herts, Abraham FitzGibbon, Mem. Inst. C. E., in his sixty-fifth year. Australian papers please copy.

INDIAN ENGINEERING.

SATURDAY, MAY 7, 1887.

LOCAL WORKS SUPERVISION IN BENGAL.

THE new rules under clauses (*l*), (*e*), and (*m*), section 138 of the Bengal Local Self-Government Act are of considerable interest at the present time, in connection with the development of the powers of Local bodies and their servants. District Engineers and their subordinates will, as heretofore, not be eligible for employment under the District Boards, unless they are thoroughly qualified for their posts. For instance, a District Engineer must either be, or have been, a member of the P. W. D., and hold a certificate of fitness from the Chief Engineer of Bengal; or he must have taken a degree in Engineering, and have been employed for five years on Engineering works, or he must have practised as a Civil Engineer for five years, and hold a certificate from the Chief Engineer of Bengal, that he is qualified for employment as District Engineer. For the future, also, every District Engineer will have to be passed, and certified to be physically fit for out-door work, by a Civil Surgeon or Assistant Surgeon on the Government establishment.

The District Engineer's relations with the Local Board will not be so independent as they have been hitherto. In the first place, he can be discharged by the District Board, after being given three months' notice of such intention. It is true that his dismissal is subject to the approval of the Commissioner of the Division, but most probably that officer would seldom exercise his power of vetoing the same, unless it was due to outrageous injustice. Secondly, the official Chairman, the Magistrate of the District, will in the end disappear from the scene, and this will make the District Engineer's position all the more difficult. Under the Local Self-Government Act, the Lieutenant-Governor may or may not appoint an official Chairman as he pleases, and in the latter case, the Board would elect their own President; even if the Lieutenant-Governor did choose to appoint, it does not follow that he would select the District Magistrate. Formerly this officer was Chairman of the Road Cess Committee *ex-officio*, and generally had sufficient influence and power to support the District Engineer if he had differences with that body.

The District Engineer has thus lost his most powerful friend, and he will now have to rely upon the tender mercies of the newly elected Board. Our opinion of Local Self-Government in Calcutta—even with an Official Chairman, and where time and experience should have taught the Municipality at least self-respect and fair play—is not sufficiently high to lead us to believe that this is a pleasant position for any man to occupy. The new *patres conscripti*, unaccustomed to authority, and with these new powers forced down their throats as it were, are certain to lose their heads at first; and it is doubtful whether they will regain them for some time to come. Every resident in India of experience will anticipate the petty jealousies and meannesses that will

characterise their debates:—for is there not a prominent example at our very door?

Were it not for the powers delegated to the Inspector of Local Works, the position of the District Engineer would be almost hopeless. Fortunately for him, however, the only official, except the Commissioner, who will have any real and effectual control over the District Board, will be a member of the same profession as himself. Even with this support, his position will always be precarious.

The new experiment will be watched with great interest, as if it is a success, the new system will eventually replace the Provincial Branch of the Public Works Department. Arrangements are already being made to hand over the roads under the care of that Branch to the Local bodies, and if everything proceeds smoothly, most of the public buildings in Bengal also will be placed under their supervision. If the elected members of the new Boards develop a proper civic spirit, this will be a step in the right direction, as well as an economical one; and although we wish the new system every success, we cannot help feeling anxious as regards the future, as it will be almost impossible to take a retrograde step hereafter in a matter of such grave public importance.

WINDING SHAFT ACCIDENTS.

When an uninitiated person descends a coal pit for the first time, the sensation is horrible enough. He clutches the crossbar of the cage convulsively, holds his breath, shuts his eyes, and thinks the chances are even whether the rope breaks, involving his untimely end, or performs its duty and takes him down and up again in safety.

But after entering pits or mines, a few times, and finding that all goes smoothly and pleasantly, the owner of any ordinary nervous system becomes quite easy in his mind and ceases to think of danger at all. Miners and mining engineers ascend and descend with no more hesitation than the ordinary public evince when they enter an express train. During the recent period of earthquakes in various parts of the world, a wag was even heard to say that the only really safe place to be in was the cage of a coal pit; for there at all events you could be hauled out of any chasm, you might happen to find yourself in!

But occasionally the growing callousness, which has been described, is rudely disturbed, and public sentiment shocked by real accidents in pit shafts; and when they do occur there is no mistake as to their appalling nature.

This is what happened on the 22nd of November, at the Aldwarkmain Colliery, near Sheffield, England.

A hundred members of a local Literary Society, bent on the acquisition of knowledge, obtained permission to descend one of the two colliery shafts. Every precaution was taken and every arrangement made by Mr. Rhodes, the certificated Manager. After the party had safely descended, a Mr. Harris, who arrived late, entered the cage with a banksman named Clayton. When the cage had accomplished 290 out of the 440 yards of its total descent, from some unexplained cause, it tilted, shot its two occupants to the bottom, to instant death, and then, becoming detached from the rope, fell on to them. Mr. Rhodes happened to be at the bottom looking up the shaft, when, hearing an unusual clatter he stepped back just in time to save his own life. It is ever in times of extreme peril that the difference between a real man and a paltroon becomes most striking. If Mr. Rhodes had lost his head under the circumstances nothing but pity could have been extended towards him. But he did not. He actually went to the hundred visitors, who were wandering about the workings totally unconscious of what had happened, and he said not a word to them, until he had seen them to the other shaft, and wound up to the surface a cage load at a time; and then, and then only, he let them know. Had they found out before, the panic which would have ensued, and the difficulty of dealing with such a number under such circumstances, is terrible to think of.

Two or three weeks since the writer of this article descended into a coal mine, the shaft of which was 75 yards deep. On re-ascending, with the lessee of the mine and another man, a sharp noise was heard, when the cage was about half way up, as though a stone had been dropped on to the roof of the cage from the pit mouth. On reaching the surface the lessee questioned the banksman somewhat rigorously as to what might have produced the noise. It appeared, however, that no one had been near the pit mouth during the ascent, and the most diligent search did not reveal any mark upon the roof of the cage. The writer however happened to notice that a bolt end, and nut, projecting horizontally from one corner of the cage was battered and bright, indicating recent contact with some equally hard projecting substance. This then was the cause of the noise. Whatever it might be that was obstructing the cage 35 yards down, it was clear that had it projected a quarter of an inch further, these lines would never have been written. No doubt the mischeivous object has now been found and removed. However that may be, the circumstance conveyed the impression that the wag was wrong in his views, when he said that the cage of a winding shaft was the safest of all places.

P. W. D. ANOMALIES.

The more closely we analyse the evidence tendered before the Sub-Committee of the Public Service Commission, by the officers of the Public Works Department, the more are we convinced that a thorough and immediate reorganization of that department, on an efficient footing, is an imperative duty on the part of Government, which could not be conveniently postponed to the distant future. There is more than *something* rotten in the State of Denmark, of which outsiders have not been able to form an accurate conception, until recent disclosures, which have excited comment from one end of the country to another. That such a state of things should have been permitted to exist for years past is an enigma to the public. As in the absence of proper discipline the greatest army in the world may be converted into a mere rabble, incapable of any sustained exertion, so for want of an *esprit de corps*, departmental management may dwindle into mere routine work devoid of life and energy. That under the circumstances brought to light day by day the

P. W. D. has not been demoralized, is a wonder, but when we come to consider that the members of the Service composing it, are true men and loyal, who merge their grievances in the zeal for public good, it is thus we find their ebullition of feelings rises no higher than deep grumbling at the hard lot. But it would, nevertheless, be not safe always to count upon implicit submission, as the outcome of a strict sense of duty. Playing with edged tools and its consequences are too well known to require any repetition from us.

The battle of Cooper's Hill and Roorkee men continues to wax warm. We will not here enter for a second time into the discussion of their comparative merits, who are fighting hard shoulder to shoulder in this struggle for existence, but we may mention *en passant* that with the accession of further evidence taken at Lahore since our last review of the subject, we observe that there is still a somewhat preponderating opinion in favour of the former on the general 'education' question.

What we are at present concerned with, is the status of the officers of the various branches of the Department in regard to the pay, past and present allowances, furlough, and lastly pension. There are so many discrepancies in this respect in the rules which govern the cases of men recruited from several sources that they deserve more than a passing notice. Let us take a typical case, that of Mr. Wright, Executive Engineer, Lucknow, who was trained at Roorkee. He thought it a hardship that he should not be put on the same footing as a Cooper's Hill man in the matter of pension till he had attained the position of a Superintending Engineer. But Mr Wright is not singular in the expression of this opinion. Colonel Swetenham, a higher authority and who has seen service of a far more varied nature during his long career, in his evidence before the Sub-Committee said:—He considered that the furlough rules granted to Stanley and Cooper's Hill Engineers should be extended to all the Engineers in the Department, provided that in the case of domiciled Europeans, Eurasians and natives, that any furlough be utilized by them in going to England, so as to have an opportunity of inspecting extensive works and otherwise expanding their knowledge. The Stanley and Cooper's Hill men were allowed a higher rate of pension, and were privileged to avail themselves of it at an earlier date than in the case of others. Europeans and Eurasians should, he thought, be treated similarly. It was also desirable that more opportunity, by a modification of the pension rules, should be allowed Government to get rid of bad bargains, say, after 15 years' service, and on a graded scale of pension.

We have given this long opinion to enable our readers to draw their own inference as to the reason why others, and Roorkee men in particular, are placed under a ban as compared with favoured men in the Service. Herein lies the secret cause of the discontent which has permeated the Department to its lowest strata. Now, we ask why is this invidious distinction in the treatment of two classes of men who serve the same Government with the same earnestness, and it may be presumed with the same knowledge of the work required of them? But it is not in one direction that this gross inequality is visible; it pervades the entire service and each set of men has some complaint to offer For instance, some of the men have been granted the benefit of the Civil Service furlough rules which have been denied to others. Again, one section has been allowed new pension rules and others deprived of them. Some have got the furlough and not the pension rules, while in the case of their fellow workers in the same field the process has been reversed. The more fortunate ones have been secured in the enjoyment of both the new furlough and pension rules, and others have had neither.

Is it not ridiculous to separate a body of men who are burdened with similar work and responsibilities and while showing paternal solicitude for one set, by giving them all the loaves and fishes of the Service, to let their comrades starve or be fed with the few crumbs that fall from the great man's table? Then, again, is it just and equitable to introduce favourable pension rules for the benefit of a portion of the Department leaving out men appointed in India without English training in the cold? This is, however, what has practically been done, in the anxiety to serve friends who, it is pretended, have particular claims on the gratitude of Government. Cases might be cited where men have been for upwards of 20 years in the service, to which the same pension rules are applicable as the rest of the Department, when suddenly new and favourable rules are granted to all sections, but the only one alluded to above. To our mind the only just course to be followed was to grant the latter to *all the men now in the Department*, with the reservation that *in future* men appointed in India would not benefit by the new rules. Had this been done no one would have cause for any reasonable complaint of having been ill-used. But as matters stand at present it is difficult to understand how this distinction is to be upheld without giving rise to serious complications and discontent.

SILICATE COTTON OR SLAG WOOL.

From practical experience it has become an established fact that air-confining or porous bodies are the best non-conductors of heat, cold, or sound. In the manufacture of *Silicate Cotton*, the threads or fibres are blown into the receiving chambers in such a manner that they fall in all possible directions with relation to each other, in consequence of which there is no parallelism or common direction in the threads, so that the air spaces are angular in shape and microscopic in size. This formation of minute cellular spaces, at irregular distances, affords the most perfect resistance to the passage of rarified air, influenced either by heat or cold, and has also the effect of breaking up and destroying sound-waves. The great power of Silicate Cotton, as a non-conductor, lying principally in its formation, allowing of the harbouring of atmospheric air in finely bi-sected air spaces, it is of the utmost importance that these spaces should not be destroyed, as would be the case if the fibre were crumbled to powder; and it is a noteworthy fact, that the fibre blown from Cleveland Slag is the only one that will not calcine under the influence of either heat, damp, or pressure.

Notes and Comments.

NEILL'S GATE, LUCKNOW.—We learn that the "Arch," which is the saddest memorial of the "Relief of Lucknow," is being rebuilt, and we endorse the suggestion that the cost of rebuilding should be borne by those who wantonly had it pulled down.

A NEW APPOINTMENT.—We are glad to hear that Mr. J. B. Buchanan, A.M.I.C.E., District Engineer, Hyderabad, Deccan, has been appointed Assistant Municipal Commissioner and Director of Municipal Sanitation for Chadarghat and the Suburbs.

PERAK STATE RAILWAY.—The post of Manager of the Thaiping Railway in Perak, vacated by the death of the late Mr. Jones, has been given by Mr. J. F. Dickson, Colonial Secretary of Singapore, to Mr. Mitchell of the Ceylon Government Railway. The post is worth £500 a year, and Mr. Mitchell may be congratulated on his good fortune.

IRRIGATION WORKS IN MADRAS, 1886-87.—The only important new project sanctioned during the year is the Periyar project, which, when completed, will greatly benefit the Madura district. Work, however, can be commenced only when funds are available. The year's allotment for the up-keep of "minor irrigation works" in the Presidency was Rs. 2,76,000. The actual expenditure was Rs. 2,56,272, or about 93 per cent.

DISTRICT MUNICIPALITIES IN THE MADRAS PRESIDENCY.—We learn that the artesian well boring at Negapatam has little or no chance of success, although the conditions assimilate to those of Pondicherry; and that a large expenditure has been incurred in the investigation of a water-supply scheme for Tanjore. In Madura and Cuddalore the water-supply has been considerably improved, while in Guntoor and Salem the matter has also been partially dealt with.

CASHMERE RAILWAYS.—It is doubted whether the projects for bringing railways into Cashmere will ever get beyond the survey stage. The reason assigned for this belief is that no particular benefit could arise, by making expensive roads into the valley, or running trains on a railway the cost of which under any circumstances would perhaps be greater than any other railway in the world, unless it be the frontier line from Sibi, where public money seems to have been wasted in a manner exceeding the characteristic waste of money by the P. W. D.

THE BURMAH P. W. BUDGET, 1887-88.—The Budget estimated expenditure on Public Works from Provincial Funds in Lower Burmah for the year 1887-88 is Rs. 11,65,000. Of this Original Works absorb Rs. 1,93,500; Repairs Rs. 5,31,000; Establishment Rs. 3,94,500 and Tools and Plant Rs. 30,000. The grant from incorporated Local Funds for Public Works by Public Works officers in Lower Burmah for the same period amounts to Rs. 3,10,900. The charges amount to Rs. 61,080; and grants for Works and Repairs to Rs. 2,05,860 and Rs. 43,960 respectively.

DISTRICT BOARD ENGINEERS.—The President of the District Board, Kurnool, in commenting on the action of the Board in refusing to meet the application of Mr. Cooper, L. F. Engineer, for an increase of pay, says that he does not think that the Board acted liberally or with a wise policy in declining to accord to a faithful servant some acknowledgment in the shape of promotion. He adds: "I do not concur in a policy which practically debars all servants of District Boards from all prospects of promotion. If we are to expect good and willing work, we should exhibit some recognition in return."

COLOMBO WATER-SUPPLY.—The report of the Commission appointed to enquire into this ghastly failure of the Maligakanda Reservoir, together with the evidence given before it, will shortly be published, as we understand all the witnesses necessary have been examined. All hope of ever utilizing the tank for the purpose for which it was originally designed is at an end, we are told, according to the Commissioners, who are said to be of opinion that the structure itself was strong enough, but that the foundations were faulty, and rendered more so by the percolation of water through the thin concrete flooring.

BOMBAY P. W. D. SECRETARYSHIP.—The proposed amalgamation of the "Public Works" and "Military" Secretaryships in Bombay would imply that the idea of appointing an outsider (C. S.) to the head of the P. W. D. has been abandoned. But the new proposal is fraught with trouble, for under this arrangement the *dual*-Secretary will, as a matter of course, be a R. E. of the P. W. D., and it can scarcely be supposed that the General Staff of the Army will placidly look on while its affairs are controlled by an officer who has practically lost touch with the Service from the enjoyment of prolonged Civil employ.

THE SILK INDUSTRY IN SOUTHERN INDIA.—Some attention has been directed to the question of the possibility of establishing the silk industry in the Madras Presidency. The trees on the leaves of which the wild silk-worm feeds are found in abundance in most of the districts, and the only question is whether cocoons can be collected or produced in sufficient quantity and whether silk can be reeled from them here, or whether they could be sent elsewhere with profit. With this view some 500 cocoons out of the collection made for the Colonial and Indian Exhibition were sent for trial to Mr. Cleghorn, C.E., a gentleman in Bengal who reels silk according to a patent process of his own invention. The cocoons had all been pierced. The result was therefore poor. But fresh and unpierced cocoons collected in the Vizagapatam district were more favorably reported upon and were considered as good as the Bengal ones.

OBITUARY.—We have to record the death of Mr. Hammond J. Engledow, Local Fund Engineer, Anantapur Circle, Madras Presidency, at Anantapur, on the 20th April last. The deceased got his training at the Engineering College, Fort St. George, and served for 28 years in the Mysore D. P. W. prior to the rendition of that province to native rule. He then returned and took up large contracts, in which he was very successful, especially in one on the Mysore State Railways, where he constructed 25 miles of the Tumkar line. After he joined the Anantapur Circle as Local Fund Engineer he carried out several reforms which were the means of improving the district and saving large sums of money. The late Mr. H. J. Engledow bore a very high character for honesty and for hard work, and it was in a great measure owing to his exposure on outdoor work that he was carried off at the early age of 39 years.

RAILWAYS IN JAPAN.—After all when we come to

figure out the results of railway enterprise in Japan up to the present, they cannot be said to be very astonishing. From published statistics on the subject, we learn that the lines actually constructed and open to traffic measure 332 miles; that those in course of construction measure 357 miles, and that those whose projection has entered the practical stage measure 145 miles. The amount spent totals twenty and a half million dollars. With the exception of the Ezo line, which is in American style, and the Osaka-Sakai line, which is said to be in German style, all the roads are on the English system. The rails, too, are chiefly English, though of late German manufacturers have received orders. Of the rolling stock, a fraction of the engines are American, the rest English, and all the wheels and axles of the carriages are English, the woodwork being now done in Japan.

THE PROPOSED RAILWAY TO TIENTSIN.—The Railway extension from Lutai to Taku and from Taku to Tientsin has been sanctioned by the Viceroy, but the promoters are divided in opinion as to the route it should follow. Those interested in the existing line from Kaiping Colliery naturally desired to have their connection with Tientsin on the northern bank of the Peiho, which would also form a natural section of the trunk lines north and south, which may be hereafter laid. Those, however, who look more particularly to local interests and local traffic prefer the south bank of the Peiho, where the line, though a good deal longer than on the opposite side, would pass through many populous villages, and both Tientsin and Taku are on the same side. It is said the Viceroy is inclined for the south side. It is understood that plans and estimates for the Tientsin-Taku railway have been submitted by M. Thevenet, on behalf of the French Syndicate, and by the American company, and that both are well supported.

THE EFFECT OF FROST ON IRON RAILS.—An American railway engineer has been experimenting on iron rails to discover the effect of frost on them, and has demonstrated that, contrary to what is generally supposed, low temperature does not decrease their strength. It is, however, true that accidents occur more frequently in cold than in warm weather. The reason for rails breaking in frosty weather is that the ground being frozen hard loses the elasticity that acts as a safeguard in milder temperatures. When a train runs on such a road, something must give way beneath the impact, and as the rails are the weakest, they are the first to yield. The frost, too, has a tendency to lift the sleepers, and thus cause an unequal distribution of weight. Extensive tests of both iron and steel rails have shown that the strength of the metal is not at all reduced by even excessively low temperatures, and that the breaking of rails is due partly to the rigidity of the ground when frozen, and partly to the displacement of the rails by the action of frost.

SIR RIVERS THOMPSON'S ADMINISTRATION.—It has been well said that the Ex.-Lieutenant-Governor of Bengal has fostered education, encouraged agricultural progress and sanitary reforms, pushed on public works to the extent of the resources at his command. In the matter of railway extension a line has lately been opened connecting the District of Mymensingh with the rising port of Naraingunge, and more recently the completion of an important section of the Trans-Ganges system, which will eventually, bring the rich province of Assam with its large tracts of waste land into direct communication with the thickly populated districts of Upper India. The Bengal-Nagpore line, for the construction of which the mercantile community and the Bengal Government have been pressing for years past, is at last to be taken in hand. This line and two other important works—the Jubilee Bridge over the Hooghly, opened a few days ago, and the Kidderpore Docks, now in course of construction—must lead, it is confidently believed, to a large development of the trade of Bengal and to the increased prosperity of the Port of Calcutta and the Province generally.

THE PROTECTED STATES OF THE MALAY PENINSULA.—The progress that has been made in these ten years in the States has been wonderful. Their financial condition has advanced by leaps and bounds. Perak and Selangore have each made a commencement in railways—modest to be sure, but designed to form the basis for further extensions. The richness of the stanniferous deposits is remarkable. Chinamen have flocked at the rate of several thousands a year to work the tin mines, and very large quantities have been extracted. It is satisfactory to know, too, that at present these quantities do not appear to be lessening to any very appreciable extent. Localities and districts may become worked out, but others take their places. The country is dependent for the bulk of its revenue on mining operations. The bulk of the mining has been done by Chinese. Several European companies commenced operations, but they were all disastrous failures. One or two Europeans are now demonstrating that money can be made in tin mining if the work is gone about in the proper way. Chinese have stepped into mines where Europeans had failed, and made them pay.

MADRAS FOREST DEPARTMENT TRAMWAYS.—Mr. J. S. Gamble, Conservator of the Northern Circle, Madras, reports that two sections of tramway line, each $1\frac{1}{8}$ miles, were purchased during the year 1886-87 from Messrs. John Fowler and Co. at a cost of Rs. 6,815 and 6,751 respectively. The first section received was set up for the Tamminaptam plantation and the second at Sriharikót. The latter was too late for much of the year's working. The results of the work for the year under review are as follows:—

	Rs.
Cost of $1\frac{1}{8}$ miles of tramway line ...	6,815
Carriage to forest	140
Laying line	60
Total ...	7,015

The work done during the year was the carriage of 2,000 tons casuarina fuel to Tamminapatam at a cost of Rs. 327 or Rs. 340, including cost of relayings. Had this fuel been carted in the ordinary way, it would have probably cost Rs. 2,000, so that the saving by the tramway has been about Rs. 1,660. If we deduct from this a percentage of $2\frac{1}{2}$ per cent. (equivalent to 10 per cent. per annum or 10 years' purchase) of the capital cost, we have a saving of Rs. 1,485 for three months' work only. This result is so encouraging that we expect before long to find similar tramway lines more generally adopted.

Current News.

The proposed scheme for the erection of a distillery at Gujranwalla to make rum on the English system appears to have fallen through.

A terrific cyclone swept over Rangoon on the morning of the 5th instant, doing an immense amount of damage all over the city.

Colonel Luard takes six months' leave. Major Cook from Madras officiates for him as Consulting Engineer to Guaranteed Railways.

Mr. Pyne, the gentleman who has undertaken the management and supervision of the Amir's workshops, arrived safely at Kabul some time ago.

On return from duty in England, Major G. Hildebrand, R.E., Superintending Engineer, Military Works Department, is posted to Beluchistan.

The Pondicherry Steam Oil Mills Company, which was formed less than two years ago, and commenced pressing operations a few months later, is to be wound up.

Mr. E. H. Hallum, 3rd grade Executive Engineer, whose services have been lent to the Southern Mahratta Railway, has been granted twenty months' leave.

The work of laying the tramway in Benares city has commenced and is expected to be completed by the end of June next. The first sod was turned on Tuesday last.

The Indian Government have so far decided in favor of the fodder compressed by the process patented by Mr. Arthur Rogers, C.E., that they purpose giving it a practical trial.

On the recommendation of the Agent, Oudh and Rohilkhund Railway, the Home Board has appointed Mr. Ryles as Locomotive and Carriage Superintendent, *vice* Mr. Buckland.

Mr. William King, A.B., D.Sc., Superintendent of the Geological Survey of India, is appointed Director of the Department, *vice* Mr. H. B. Medlicott, who retired on the 27th ultimo.

Mr. H. J. S. Cotton is appointed to be President of the Boiler Commission under Act III., B. C. of 1879, in the town and suburbs of Calcutta and in Howrah in the place of Sir H. L. Harrison.

The construction of the reservoir close to the hills at Jamalpore, for which the E. I. R. Company has voted a large outlay, is making great progress, and is expected to be ready before the rains.

Mr. J. C. Rogers, C.E., has taken out a patent for a sugarcane-crushing mill, invented by him. The new mill is likely to be more expensive than the well-known machine of Messrs. Thomson and Mylne.

Major Shepherd, lately employed on the Hurnai Railway, probably succeeds Colonel Wallace, R.E., who shortly takes charge of the North-Western Railway from Colonel Conway-Gordon.

The question of a railway to Simla has advanced a stage. The Government is now in negotiation with the native Chiefs through whose States the proposed line runs, for the purpose of taking up the necessary land.

Colonel Bowen, Secretary to the Mysore Government, Public Works Department, is to have his service in the Mysore State extended four years. Major Kensington, who has returned to India, will be Colonel Bowen's Assistant.

Mr. Higgins, Executive Engineer, is drawing up water-works projects for the town of Akola, Shegaon, and Buldana. Mr. Glass, Superintending Engineer, is determined to give the Berars a good supply of water, as he has done in Jubbulpore.

The Kaiser-i-Hind Bridge over the Sutlej at Ferozepore was duly opened by the Lieutenant-Governor of the Punjab on 30th April. It would appear that the elaborate programme of proceedings was considerably interfered with and curtailed by a furious dust-storm.

It is said that the Government of India has decided that Royal Engineer officers serving in the Military Works Department who have not elected for continuous service in India, remain as heretofore subject to the Regulations of 1868, and are ineligible for special leave.

All the girders of the Jhelum Bridge up to pier 16 are in position. Two only remain to be erected. The span between piers 16 and 17 is giving some trouble, on account of the rising of the river, and the deep scour which has set in towards that shore, to resist which large quantities of stone were being thrown in.

Mr. Wynne, the Engineer-in-Chief of the Nagpore-Bengal Railway, has so high an appreciation of the training at Cooper's Hill College that he has selected seven of his staff from amongst the students of that College, who have not entered into Government appointments. Mr. Wynne is a Cooper's Hill man himself.

A fatal accident occurred on Tuesday evening at the Kristna bridge on the Koregan-Miraj section of the West Deccan Railways. A girder was blown down by the heavy wind, killing six coolies on the spot, and wounding other eight, who are not expected to recover. This section is nearly completed, and will probably be opened early next week.

The following Royal Engineer officers have been transferred from the Bombay to the Bengal Presidency, and have been posted as follows:—Lieutenant H. V. Biggs to the Presidency and Oudh Commands as an attached officer to the Military Works Department; and Lieutenants C. S. Rose and E. D. Bullen to the Bengal Sappers and Miners.

Colonel Pemberton and Mr. Molesworth have returned to Simla, armed with the results of their enquiry into the expenditure on the Sind-Pishin Railway, and their report is to be issued from there. The most diplomatic reserve was maintained during the enquiry, but its tendency during progress indicated a disposition to make things smooth all round.

A Bombay paper says—We mentioned a few days ago the possibility of radical changes being carried out, which will place the Public Works Department under some other branch of the Secretariat. We now hear that it is in contemplation to amalgamate the Public Works and the Military Secretaryships. The appointment of Joint Secretaryship has not yet been made.

It is said that Sir Bradford Leslie contemplates, during his stay in England, raising again the question of a Central Railway Station on a convenient site in Calcutta, for all the Railways to be connected by the new Hooghly Bridge, and having it finally settled both by the Board of Directors of the East Indian Railway Company at Home and the Secretary of State for India.

It is reported from London that the Government have decided to re-open the question of the Madras Harbour project. It is the local opinion that the eastern entrance to the Madras Harbour is defective. The subject came before the India Office, and an English Committee of Engineers was appointed, who visited Madras and reported against local opinion. The matter, nevertheless, remained in an unsettled state, and now the India Office has decided to re-open the question by referring it to Sir John Coode, Sir George Nares, and a nautical man—probably the Commodore of the P. and O. Company. The question is really one of engineering *versus* nautical opinion.

Two construction Divisions have been formed of S. M. Mysore line, one, the southern, extending from the 155th mile to Gubbi. This division is 100 miles in length. The Northern Division is from Harihar to the 155th mile, and is 57 miles in length. Mr. Mackenzie will carry out the works in this Division, in addition to that of the *South Extension Division* at Hubli, which is his ordinary charge. The works will commence in the Southern Division on the return of Mr. Buyers from Poona, who is expected shortly. The Northern Division of the line has already been commenced. Several contractors have started with labourers to collect materials, and to push on the works at once.

We regret to have to record the death, from pneumonia, at his residence, St. Thomé, Madras, of Mr. John Hennessy, at the age of thirty-nine. Mr. Hennessy was the eldest son of Major Hennessy, late of the Camp Equipage Depôt, and Superintendent of the Technical Section of the Public Works Secretariat Department. The deceased was educated at St. Mary's Seminary, and subsequently at the Civil Engineering College, whence he passed out many years ago. Shortly after he joined the Department he resigned his appointment and became Drawing and Surveying Master of the Civil Engineering College. After remaining here a few years he took up the appointment in the P. W. D. Secretariat which he held at the time of his death, and which had been created for him by Colonel Sankey, R.E., then Secretary to Government and Chief Engineer, P. W. D.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

THE PROTECTION OF INVENTIONS AND DESIGNS BILL—1887.

Sir,—The *Pioneer* of the 23rd instant endeavours to impress (but with ill success) the view that there is some *misconception* existing regarding the new Indian Inventions and Designs Bill, particularly as regards the fees to be paid. I wish it were so, but the fact remains self-evident that a patent in future for 14 years will cost Rs. 540, which we now obtain for Rs. 100 only. There is no misconception in this, and it is not to be palliated by the statement that the amount is to be paid in small or gradual instalments, for this is no real advantage or help to the inventor, but it will rather tend to discourage invention as I shall presently show.

Now, I cannot allow "that in no other country in the world can a patent be obtained more cheaply than in India even at its present cost of Rs. 100, for one we can obtain for 17 years for nearly the same amount in the advancing United States of America. Yet granting it were a fact, the few applications now made were a good reason for reducing rather than for enhancing the cost, as we could thereby encourage inventors and so bring the country forward, which it much needs."

The absurd reason given for enhancing the cost of patents is, "that it is intended to have a Special Invention Office, as other countries have" and to have this "the Indian Government must

raise their fees." Now we do not require a new ornamental building to hold the records of the Patent Office, and it were a pity that for this absurd purpose that the true interests of the country should be sacrificed. The Patent Office is well enough located in the Home Department, and the cost of the establishment is from all appearances more than covered by the present fees. The surplus may certainly be well utilized in forming a Patent Museum.

The result of the last 25 years' experience of the Patent Office clearly shows that the Indian patent is not much valued or sought for even at the cheap cost of Rs. 100, as hereby an average of 200 patents have been filed annually. Lately there has been some small increase in the number of the applications chiefly British and Foreign, but this will certainly fall off, even to much below the average stated, as only paying patents would in future incur the extra cost.

Small preliminary instalments will no doubt induce many poor local inventors to rush in for patents in the delusive hope that they will find some enterprising individual to help or join them ; and a few no doubt will be successful, but to the majority it will prove but a delusion, a loss of their time and their invention. A lapsed invention benefits no one ; certainly not the public, for no one would care to take up or work an invention open to general competition.

Besides this we are approaching a time when inventions will be played out, as it is there is now almost a block in the way of inventors. Many an inventor after much thought and trial in experiments, believing that he has a good invention, has gone away disappointed on finding out by a search that he has been anticipated. In fact, it is difficult now to have a patent passed in any of the following class of inventions :—Sugarcane crushing mills, oil mills, tea rolling mills, tea drying apparatus, tea straining or separating machines, indigo improvements, silk drying and reeling apparatus, improvements in ploughs, fibre cleaning machines, bridge construction, and a few others. The chances are ten to one that it will be returned to the inventor with the remark that it is not new or novel. What is really needed in the new Patent Bill is a clause making old or lapsed inventions re-patentable, provided they are not used, or only used by very few, to whom the use should be continued.

INVENTOR.

NON-RECOGNITION OF GOVERNMENT ENGINEERS.

SIR,—In INDIAN ENGINEERING of 6th April you have noticed Colonel Trevor's reminder that Engineers of the Public Works Department cannot hope to receive those distinctions or honours which appear, as a matter of course, to fall to the lot of officers in other departments, unless they have earned the reward by work independent of their own profession. The enclosed extract from a pamphlet written by Colonel McLeod Innes in 1881 confirms Colonel Trevor's opinion, and the late distribution of Jubilee honours proves the disgraceful neglect of the just claims of Public Works officers prevalent with the Government of India.

"The Public Works Department is, in every important matter, the least favored service in the State, and holds a very invidious position in its general polity. The emoluments and prospects are worse than those of most other departments ; it receives none of the honors and distinctions which fall to their lot ; and the services which it has to render to them, or the duties it has to fulfil on their account, tend to place its officers on a more or less subordinate footing.

"As to emoluments, investigations made last year showed that a Royal Engineer in the Public Works Department draws, during his career in it, almost precisely the same amount as a Staff Corps Officer of Native Infantry—rather more in the lower, considerably less in the upper, ranks—while it need hardly be remarked that the military service, in addition enjoys all the Army staff appointments, and is also eligible for posts in the Political Department and in the Civil Administration of the country. The Royal Engineer therefore in the Public Works Department does not fare so well as a Staff Corps Officer of the Native Infantry, while the *Civil Engineer is still worse off* by the monthly amount of Rs.129, which is the average difference between the pay of the Royal and the Civil Engineer.

"Obviously, then, there is no room for comparison in respect of emoluments, between even the Army and the Public Works Department.

"As to prospects, the only post of the highest class appertaining to the Department has been recently abolished, and there is now but one officer in it enjoying pay and position equal to that of a general of military division or superior to that of the Commissioner of a civil *division* of a province.

"It does not contain or afford an opening to any appointment analogous to the superior posts in the Civil Administration, the Political Department, the Bench, or the Council; and outside the Department its members, —*its civilian members at any rate*—have no prospects whatever.

"As for the higher honors and distinctions that are conferred by the Crown, the customary reward and recognition of public service, they seem practically barred to the Public Works Department. During the last quarter of a century but one of its officers have been honored with Knighthood, and only two now in it with the Companionship of the Bath or of the Star of India for service in it. Only one indeed of these three cases was in recognition of *purely departmental services*, the other two having been earned in connection with famine relief operations.

"And yet during this period surely the material development of the country has played no unimportant part in its administration, its results appearing to argue services which, though perhaps not so brilliant as those that have been leading to distinction in the Army, the diplomatic circle, or the Civil Government, may be held sufficiently valuable and eminent to call for some slight recognition.

"In the Public Works Department then the work is hard ; the duty frequently unpleasant. Most of its officers have entered it by competition—some of them by competition of a high standard ; and yet they find themselves in the back-ground in every point to which importance attaches in a service—in honors, in place, in prospects, in emoluments."

P. W. D.

REPRODUCTIVE PUBLIC WORKS.

SIR,—"It is literally true that the reproductive Public Works of India, far from paying their own interest, in many cases do not pay for their working expenses, and have proved largely instrumental in driving the finances of the country into their present unsatisfactory condition. If some of the great irrigation works, specially in Southern India, have been magnificently successful, it is no less the case that irrigation projects have been extended elsewhere to tracts of country where they are altogether unnecessary and unsuitable ; while the interest payable on the cost of their construction remains a heavy annual tax on provinces which can profit nothing from them. These works are too often a source of oppression to the people whose lands are irrigated. The rapid extension of the Railway system all over India may be justified by pointing to the immense assistance which railway communication affords in dealing with famine. But from a purely financial point of view it involves an amount of outlay which the country is incapable of making remunerative. Even the old established lines which tap the most fertile and productive districts and which connect the most populous and wealthy trading cities with the sea-coast yield only a precarious profit. They prosper when their receipts are swollen by returns from famine or war traffic. The new lines, now under construction, and contemplation, which, if I may use the metaphor, break up inferior soil are naturally supported by the local officials whose isolated position is ameliorated by railway extension and by Engineering authorities for whom the railways find employment. The promoters of these railways who most loudly insist on the profitable character of their speculations are not however really deceived, for they will not invest their money without guarantee from Government and other substantial privileges. If they believed in their experiments they would proceed in them without Government assistance. This is the crucial test in all such cases. The assurance that railways will develope the resources of the country is an altogether insufficient warrant for their construction. The proper course is to abandon the project to private enterprise. If intending investors have confidence in their own glowing anticipations, they may be left to incur reponsibility as well as enjoy profits. The Government for its own part should refrain from further railway extension, which cannot be shown to be necessary for the prevention of famine."

The above extract from Mr. Cotton's *New India*, page 62 shows how unprofitable are the so-called reproductive Public Works of India. No less so are those carried out with the Public Works and Road Cess monies. The lion's share of these are still absorbed by the salaries of large establishment and the rest frittered away on ill-considered projects. About 3 years ago some 30,000 rupees were spent in the Bhagulpore District for raising an inundated road which is now abandoned and in the Monghyr District the Magistrate reports that the conversion of the Tirhoot road into a *bund* has led to serious complaints from zemindars and ryots. While money is thus frittered away for impracticable and useless purposes, the people are deprived of the means of providing themselves with their own real wants, such as wells, tanks, *bunds* and irrigation channels. If any one were to read the Road Cess reports published in the *Calcutta Gazette* he would see how useless are these reports when they do not contain one sentence of criticism from the head of Government to whom they are submitted.

The Magistrates complain that the Committees are not attended by the members. The reason why the members are inattentive is obvious. They no longer are satisfied with the mere honor of being members of Committees. They see the hollowness of the system under which they exist, and as most members are not independent enough to resist measures intended to waste public money, they naturally keep themselves aloof from the Committee room. Of Municipal Public Works the same may be said generally. The late Lieutenant-Governor was a great admirer of native energy and bestowed titles with an unsparing hand on those who could come forward with schemes of public improvement. Bhaugulpore was specially fruitful in the growth of such characters under his benign influence. The wisdom of the present ruler of Bengal, it is to be hoped, may avert the repetition of such catastrophes.

INDIAN OBSERVER.

General Articles.

PORTABLE STAGING FOR GIRDER ERECTION.

In the annexed Plate are Drawings showing the Staging recently employed on the South Indian Railway for a "Whipple and Murphy" pattern Girder Bridge. The chief feature of the Staging here described is its *portability*. The Drawings are self-explanatory.

Plan No. 1 shows:

Elevation of girder and staging on a bed of sleepers.

A. Being fitted and resting on the wedges. Joists boarded with mangoe planking.

B. Wedges taken off and the joists laid down to get ready for fitting the cross girders and rail-bearers.

C. The cross girders and rail, &c., fitted up and completed for the main timbers to be fixed.

Plan No. 2 shows:

D. Sleepers laid (on the made up earth bed) in stream, between piers.

E. Planking mangoe on joists and the rails spiked.

F. Shows the joists and rails.

Plan No. 3 shows:

Cross Section.

G. Shows a cross section with a lattice bracing top of booms.

H. The timbers, cross girders, rail-bearers, &c., fitted and finished.

I. Showing the rails and mangoe planking.

J. Shows the uprights of staging, braced (the diagonals are rails.)

K. Pier built on wells.

L. 12 feet masonry well, with mangoe plank curb and cutter.

The iron work was fitted up with a 5-ton travelling crane, and good jacks.

J. E. B.

SEWERAGE SCHEME FOR KARACHI CITY AND ITS SUBURBS.

By J. Strachan, M. Inst. C. E., Municipal Engineer.

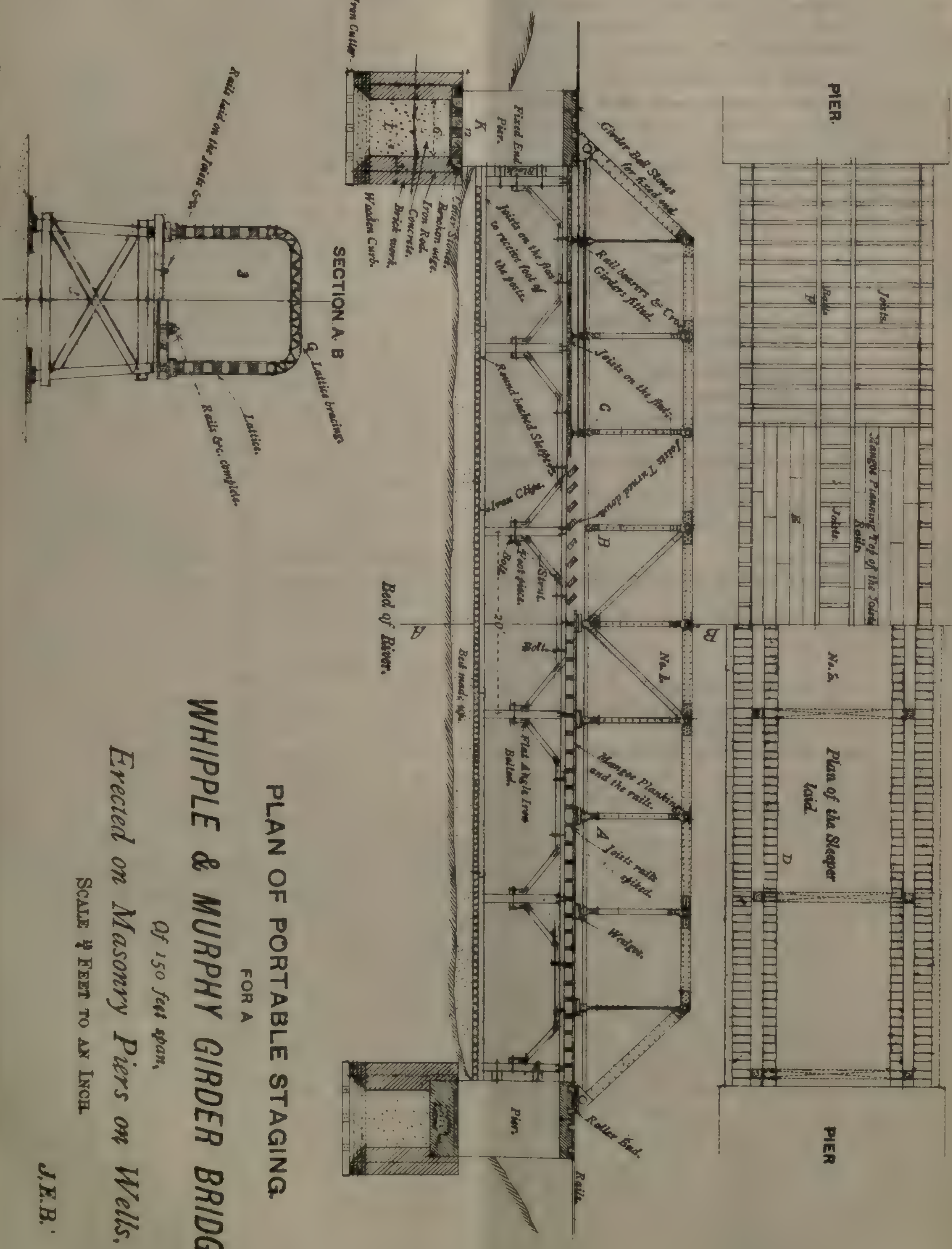
Ever since the introduction into Karachi of a copious supply of sweet water a system of sewerage for the Town and Camp has been daily a matter of more and more pressing necessity, and the time has almost now arrived when a farther delay in the execution of this project may cause serious results. The improvement in the health of the inhabitants of Karachi, which followed the introduction of pure drinking water into the Town may, and most likely will, in its turn be succeeded by a time of sickness unless prompt measures are taken for the effectual removal of all waste water, sullage and night soil. Many of the Municipal Commissioners, realizing fully the important facts that the prosperity of a city is closely connected with the health of its inhabitants and that the conditions under which the people live determine whether their lives shall be long or short; attended by health or sickness, have requested me to submit a report embracing a proposal for a scheme of sewerage for Karachi. In compliance with this request I have drawn up the following report on the subject.

2. From time immemorial the sullage and other waste waters of the Native town of Karachi have been either collected in cesspools of which there are great numbers, or thrown on the streets and lanes with this result that the soil is soaked with sewage and the health of the inhabitants endangered. Previous to 1875 these cesspools were built according to the will and pleasure or more probably the means at the disposal of the persons constructing them. Mostly, they were holes some 10 feet deep lined with rubble stone, set dry, so that their contents could all the more easily percolate through the wall and be absorbed by the surrounding ground; they were seldom cleaned, for, in fact, their contents escaped readily enough, and the pipes connecting them with the houses were never trapped. The result of this state of things can easily be imagined, the wonder is that with such a seething mass of rotteness the city of Karachi has escaped so well as it has done. Since 1875 the cesspools have been built on a standard plan; the walls are of stone and lime and the connecting pipe has been trapped and ventilating pipes have been erected; but the proportion of old cesspools to new is very great and the necessity for some radical change is imperative, for the system is one of the worst that could be devised. The disjecta from the latrines is at present collected by hand and along with the street sweepings is conveyed to the rubbish depôt where it is disposed of. So far then, with the exception of a few thousand feet of earthenware pipes laid to carry off the water from a few of the street services, there is nothing in the present arrangements which can fetter the Municipality in the consideration of a sewerage scheme or can bias any one in favour of one project more than another.

3. Before designing a sewerage scheme for Karachi, the first point to decide is, what is to be the nature of the scheme? Is it to be one combining the disposal of the sullage, closet and storm waters; or is it to be one by which only house sullage and bath room waters are allowed to pass through the drains; or is it to be a scheme providing for the removal of house sullage, bath water, and closet refuse? In deciding this question local circumstances must have primary consideration and will in a great measure regulate our choice.

4. The rainfall in Karachi is occasionally very heavy amounting at times to nearly one inch in an hour. The area drained by the present water channels is very large amounting to 2,900 acres; the discharge therefore is, in time of rain, very great, and to provide for such a volume of water in the new drains will be almost an impossibility. Besides, as the present water channels are quite capable of conveniently carrying off the total rainfall it would be needlessly increasing the cost of any system of sewerage were any provision made under this head. The question of the admission or exclusion of storm waters from the sewers may then be answered at once in the negative.

5. It remains now to decide whether, in addition to house sullage, bath room water and the like, fœcal matter will also be admitted into the sewers? In order to decide this point it will have to be borne in mind that the exclusion from the sewers of all solid dejections implies the continuance in the town of that most disgusting and barbarous of practices, *viz.*, the collection of excreta by hand from private and public latrines; it means also the continuance of several of the most objectionable nuisances which at present afflict the inhabitants of the town; it means, under present arrangements for scavenging, the deposit of night soil on the streets and in the dust-bins, a practice offensive both to sight and smell; it means, even under the most perfect system of hand collection that could be devised and with the best appliances, an amount of inconvenience and annoyance from the mere presence of sweepers in the house, that most people would give a good deal to avoid. There will be, it is true on the other hand difficulties to contend with in connection with the system of closets which will be an accompaniment of the sewerage scheme. The people will be, for a considerable time, more or less ignorant of the working of the closets, and the machinery connected with them will go out of order and require careful attention for some time after their introduction, but there is nothing in this that may not be easily overcome. There is also the danger arising from the accumulation of deleterious gases in the sewers. This is considered by some to be a grave and serious danger. Experience, however, goes to prove that with a well designed and properly ventilated system of sewers, fears on this head are groundless, and in India where the houses are well ventilated, the danger is less than in other places. I need only refer to the city of London to prove the ground-



PLAN OF PORTABLE STAGING.
FOR A
WHIPPLE & MURPHY GIRDER BRIDGE.
Of 150 feet span,
Erected on Masonry Piers on Wells.
SCALE [illegible] FEET TO AN INCH
J.E.B.

[illegible] Star Press, [illegible] Street, Calcutta

lessness of any alarm on this head. London with its many miles of sewers is yet one of the healthiest cities in the British Empire. The following table, comparing the death rate of 1784 with that of 1883, will also show what has been accomplished in a number of large towns in England, all of which have now sewerage systems.

The death rate of the following large towns for the years 1784-1883, compared :—

	1784.	1883.
London	48·1	20·4
Edinburgh	48·0	19·2
Dublin	45·4	29·2
Leeds	46·2	23·3
Northampton ...	37·8	17·5
Shrewsbury	37·8	19·8
Liverpool	36 3	26·7
Manchester	35·7	27·6

Again it has been noticed from the Registrar General's returns that Towns having sewers with steep gradients were generally those which had a high death rate from Zymotic diseases while towns with sewers with a flat gradient had generally a low death rate, and there can be no doubt that steep sewers rising to a considerable elevation will act as shafts for carrying sewer gases, unless proper precautions are taken to prevent this by means of ventilation. Such danger need not, however, be apprehended in Karachi, as all the sewers will have gradients of the very flattest description consistent with self-cleaning. With reference, therefore, to the question as to the exclusion from, or admission into, the sewer, of the fœcal matter from latrines, I am of opinion, after due consideration of all the circumstances, that the latter course should be adopted and the fœcal matter admitted. Of course it is understood that a water carriage system as now proposed, still entails the removal of house refuse, ashes, dust, and street sweepings, by the hand and cart collection system as at present.

6. Having settled the nature of the sewerage system to be adopted, the next question which arises for consideration, is a most important one, and refers to the manner of disposal of the sewage.

Four systems may here be submitted for your consideration.

1st.—Treatment with chemicals.

2nd.—The Pneumatic systems (Liernur's and Shones.)

3rd.—The tidal outfall, and

4th.—The application of sewage to Land by means of irrigation.

7. Regarding the first of these systems, *viz.*: the treatment of sewage with chemicals many processes have been invented and many experiments tried, but all have proved more or less failures. The chief object with all those who have studied this system, has been to extract from the sewage all its manurial elements in a compact form, so that concurrently with a fairly pure effluent, which can be passed into the nearest river or water course, a profit may be made on its sale for agricultural purposes. Experience has proved that the purification of sewage by precipitation can be carried out successfully, but it has also been proved that as a mercantile transaction it is a very great failure. The result of the best process known of purifying sewage by chemicals, according to a recent report of the River's Pollution Commission, was that, while it separated the whole of the suspended matters it not only failed to remove the putrescent matters in solution but actually increased their quantity. This treatment had to be abandoned at Bradford, Clifton, Cheltenham and other places. Taking it for granted that the effluent would be, by the kind permission of the Harbour Board, allowed to flow into the Harbour (which would be the only convenient means of disposing of it, unless it were pumped on to land in the trans-Lyari district), there would still remain the very serious difficulty as to the cost of the process and the disposal of the immense quantities of sludge which all those chemical processes produce.

(To be continued.)

TRIPLE-EXPANSION ENGINES.

CAREFUL observations, confirmed by experience, go to shew that engines of this type as designed for marine purposes, have attained the greatest efficiency when placed side by side and working on the same axis or shaft by three equi-angular cranks. Besides the above there are other conditions which directly bear on the efficiency of engines built on the principle suggested above. For example it is considered an advantage, though not conducing to the effectiveness of the engines, to have the cylinders steam jacketed. This is done generally by casting the working barrel and the jacket piece separately and afterwards accurately fitting them together. Without the jacket there is considerable condensation of steam, which means a larger consumption of fuel and in the case of the shell of the cylinder cracking. The expense and inconvenience of renewal are great. The ratios of cylinder capacities should be so arranged or proportioned that, in the case of a cargo boat, where the consumption of fuel is of utmost importance, "the high pressure cylinder should be of such a diameter that with a cut off at from 50 to 60 per cent the theoretical terminal pressure in the low pressure cylinder shall not exceed 10lbs. per square inch."

In triple type engines, with three cranks, the middle cylinder should be so proportioned that, with 55 to 60 per cent cut off, there should be as approximate equality in the temperatures, the powers, and stresses, of all three cylinders as it is possible practically to attain.

Indirectness in steam pipes, and unnecessary number of stop valves between the boilers and engines, have been found to affect the indicated initial pressure considerably, in very many cases to the extent of 10 per cent.

Wire drawing is found to increase in instances where the triple-expansion engines are fitted with piston instead of ordinary slide valves. The low pressure cylinder being the source of the greatest ineffiecency should have its ports and exhaust passages small, and the velocity of the steam entering and leaving it should not be too high to cause extra resistance. From irregularity in this respect the formation of vacuum is affected injuriously. Tri-crank engines possessing as they do a more uniform twisting moment on the shaft are capable of high piston speed. The best arrangement for the order of sequence of the three cranks is " the high pressure leading, low pressure following, and the intermediate or middle one last."

In the tandem type it is difficult to secure equality of temperatures, stresses and powers, and hence its ineffectiveness. The converted " compound " engines having the third cylinder on the top of the high pressure or low pressure are equally objectionable.

The advantages of the three crank, over other type of marine engines, summarised, are: 1*st*, more uniform strain on the shaft; 2*nd*, economy in the build of the engine, being lighter in proportion to the power developed; 3*rd*, higher piston velocity possible and safe under the arrangement; 4*th*, less wear and tear; 5*th*, interchange ability of parts and easier accessibility of the working parts; 6*th*, facility for repairs; and 7*th*, easier adjustment of temperatures, stresses, and powers.

Of all valve gearing employed in the working of this class of engines the *single* eccentric valve gear has been found to be the most suitable for the perfect distribution of steam.

The results practically obtained from the working of triple-expansion engines constructed on the three crank principle show a saving in the consumption of fuel of no less than 30 per cent. which now-a-days is of vital importance to ship owners in this country and elsewhere. The bunker room thus relieved becomes available for cargo which is an additional gain to them.

The evolution in marine engineering has of late years been as rapid as in other branches of mechanical engineering. The *oscillating* engines are now almost things of the past, the *compound ones* are gradualy but surely giving place to the *triple*, and these we are told will soon be superseded, by the *quadruple*! Who can say what *iple* or *uple* will follow next? J. C.

THE GEOMETRY OF THE OBLIQUE ARCH.

By A. Ewbank.

II.

In *fig.* 2 the pitch of the spiral B T K is accurately shown by the angle which T I, parallel to A B, makes with the tangent at T to the projection curve K T B. In other words, at that point of the spiral, whose projection is T, the real curve on the cylinder is parallel to the plane of the paper and angles there are not distorted by orthogonal projection.

Let us now suppose J J′ in *fig.* 2 to denote in direction the vertical plane of the oblique face. Let the line T J be normal to the tangent line at T to the curve K T B. Thus we have arranged that the oblique face is met at right angles by that intrados coursing line which comes to the face at the inner crown of the arch. But now if we proceed to draw other intrados lines with the *same* pitch, as we must naturally do if we build with equal sized and rectangular stones, we shall find that the other intrados lines do not meet the face at right angles.

To make this clear let us consult *fig.* 4. The plane of the paper is here supposed to be vertical and to be due east and west. O *y* is a vertical line drawn from O, a point in the axis of the cylinder and directed upwards. O*x* is directed east. O*z* is the axis of the cylinder or the line passing down the middle of the road over which the arch is thrown. This line is due south and is directed towards the observer who, accordingly, holding the plane of the paper vertical, is himself looking due *north* along the line *z* O.

The plane of *y* O *z* is thus the meridian. This plane and the plane of the road *z* O *x* together cut a quarter out of the cylinder, *viz.*, the upper east quarter of the cylinder. Through O *y* passes the oblique face of the arch. Its trace on the roadway is along the line O R. K M in this figure corresponds to B Q L in *fig.* 1. It is the east side line of the road or it is a generating line of the inner cylindrical surface. We have made one spiral line of pitch β meet the arch face at its top. The other spiral lines of the same family will meet the arch curve, which is an ellipse, at various points. The planes *y* O *z* and *z* O *x* will cut out one quarter of this complete ellipse, *viz.*, the upper east quarter—or we may call it the east half of the arch which itself is only a semi-ellipse.

We will now examine that particular spiral which is the last of the family in the east half of the arch semi-ellipse. This spiral would meet the arch in the roadway. We of course neglect any constructive differences between the various parts of the arch, for these differences are rather architecturally desirable than geometrically necessary. This particular spiral is as it were rising out of the roadway and meeting the face of the arch at the point K. K L is the tangent at K to this spiral. Take K L a length unity along this line. Draw L M vertically downwards to the roadway. Draw M R normal to the trace O R. In the face of the arch draw S R vertically upwards and equal to L M. Join L S and K S. Then L S is the perpendicular drawn from L to the plane of the arch face.

Fig. 1.

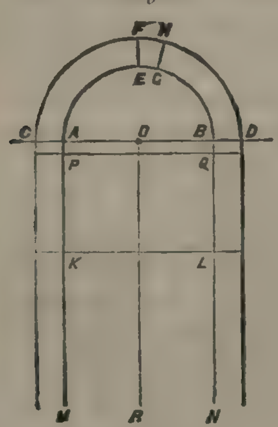


Fig. 2.

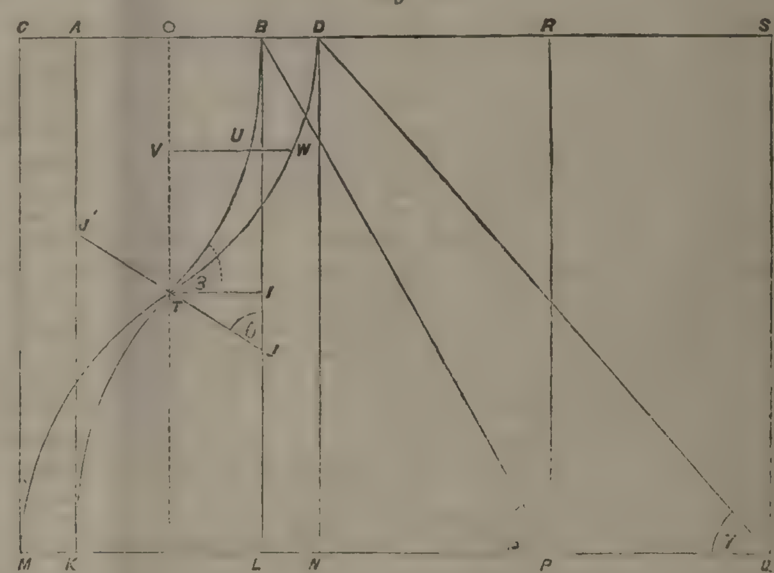


Fig. 4.

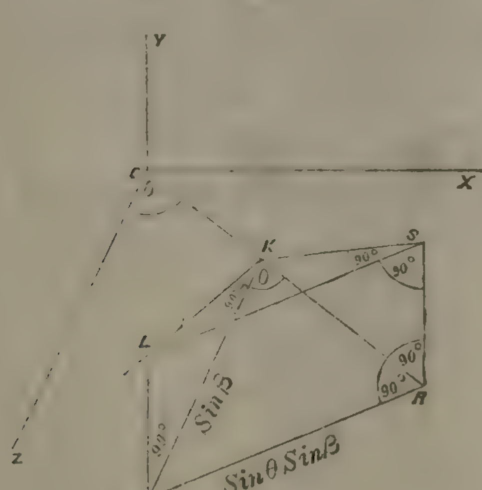
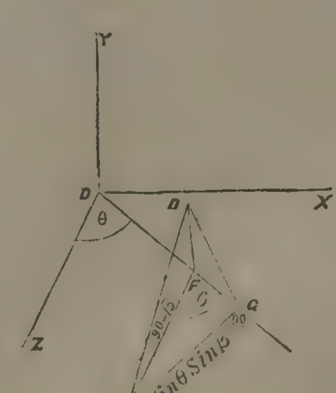


Fig. 5.



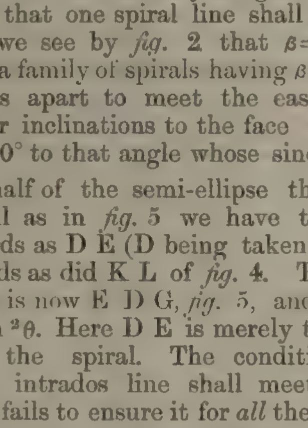
The angles L M R and M R S are right angles, besides those indicated in the diagram.

The pitch of each spiral is β. Therefore, L K M is $90-\beta$, being equal to the angle R P B of *fig.* 2. K M is parallel to O z. Therefore, M K R $=\theta$, *i.e.*, the obliquity of the face. The plane L K M, containing the tangent line at K to the spiral, is a tangent plane to the inner cylinder and is parallel to the plane y O z. The figure gives Sin β for the length K M, the line K L being unity. Then in the triangle M K R we have M R $=$ Sin θ Sin β. L S is equal and parallel to M R. In the triangle L K S the required inclination of the line K L to the arch face is the angle L K S. Thus Sin L K S $=$ Sin θ Sin β. This is true for any assigned pitch, but as we have decided that one spiral line shall meet the face at right angles, we see by *fig.* 2 that $\beta=\theta$. We may now infer that if a family of spirals having $\beta=\theta$ are drawn at small distances apart to meet the east half of the semi-ellipse, their inclinations to the face would change gradually from 90° to that angle whose sine $=\text{Sin}^2\theta$.

On the west half of the semi-ellipse the inclinations also diminish till as in *fig.* 5 we have the spiral line passing downwards as D E (D being taken in the face) instead of upwards as did K L of *fig.* 4. The inclination to the plane face is now E D G, *fig.* 5, and Sin E D G $=$ Sin θ Sin $\beta=\text{Sin}^2\theta$. Here D E is merely the direction of the tangent to the spiral. The condition $\beta=\theta$ thus ensures that one intrados line shall meet the arch at right angles, but fails to ensure it for *all* the others.

Instead of assuming $\beta=\theta$ we might assume tan $\beta=$ 2 tan θ, or say μ tan θ whose μ is some constant greater or less than unity. This gives the spiral lines of a constant pitch differing from the former, but when we take the particular case $\theta=90$ we still have $\beta=90°$. That is with tan $\beta=\mu$ tan θ we still have the arrangements of *fig.* 1 resulting as a particular case from the general construction.

Fig. 3.



One particular value of μ is obtained as follows. In *fig.* 3 let us take the angle R M N $=90$. Thus $\beta=\phi=$ $90°-$ B R M. M R is the development of that spiral (*not* of the intrados family) which leaves the semi-ellipse at one base point A and meets it again at the other base point M. This spiral also cuts the ellipse at its highest point as is indicated by the point T in *fig.* 3. At this highest point this spiral cuts at right angles that spiral of the intrados family whose pitch is determined by the new relation $\beta=\phi$, and which is drawn through this highest point of the inner arch.

Now here tan $\beta=$ tan $\phi=\frac{\pi}{2}$ tan θ. Thus $\mu=\frac{\pi}{2}$

When the elliptic semi-circumference is developed we have the wavy line M T R and the straight line M R may be said to give the average pitch of this wavy line. This method of assigning the pitch of the intrados coursing lines may be thus described. Run a spiral line through the extremities of the transverse axis of the ellipse and the top of the minor axis. If this have a pitch γ the pitch required for the intrados coursing lines will be $90°-\gamma$.

This method is prescribed by Mr. G. Watson Buck in his "Essay on Oblique Bridges." We will now shew that it does not give a right angle at the crossing of the arch nor indeed anywhere for the inclination of the intrados line to the arch face.

(To be continued.)

MR. HENRY BENEDICT MEDLICOTT, A.M., F.R.S. F.G.S.

A GRADUATE of Dublin (L. C. E. 1850). Engaged by Dr. Oldham from the Geological Survey of Great Britain; joined appointment in India on 24th March 1854; in August 1854 appointed by Court of Directors as Professor of Geology, Roorkee College; reattached to Geological Survey for the field season; 1854-55, Narbada Valley; 1855-56, Sub-Himalayas; 1856-57, Bundelkhand; 1857 to 1862, Sub-Himalayas; received the Indian Mutiny medal for special service in Rohilkund; in October 1862 left Roorkee and rejoined the Geological Survey as Deputy Superintendent for Bengal; 1862-63, South Rewah; 1863-64, Behar; 1864-65, Assam; officiated as Superintendent from 21st August to 13th November 1864; leave on private affairs from 10th May to 9th November 1865; 1865-66, Central India and Rajputana; 1866-67 Chota Nagpur, Chhattisgarh, Sambalpur; placed in the 1st grade on the introduction of grading in May 1866; 1867-68, Garo Hills; 1868-69, Hazaribagh, Sirgujah, Sohagpur, Chanda, Mohpani; 1869-70, Satpuras; 1870-71, Bundlekhand, Narbada Valley; officiated as Superintendent from 20th July to 5th September 1870; sick leave 13th June to 2nd December 1871; 1871 to 1873, Satpuras; officiated as Superintendent from 16th July 1873 to 15th December 1874; 1873-74, Garo Hills; 1874-75, Betwa coal-field, Nimar, Nepal; 1875-76, Nimar, Jhansi Hills; appointed Superintendent on 1st April 1876; Fellow of the Calcutta University, and Member of the Faculty of Arts and Engineering, 17th April 1876; 1876-77 Mohpani and Satpura Coal-borings; 1877-78 Reh Committee and Nahan; 1878-79 and 1879-80, Office, Calcutta; 1880-81 Nahan and Office, Calcutta; 1881-82-83-84 Office, Calcutta; extension of service for two years from 2nd August 1884; special leave from 19th May to 8th November 1884; 1884-85 Office, Calcutta; designation changed to Director of the Geological Survey of India; 1885-86 Office Calcutta.

He has contributed to the Survey publications 5 Memoirs, 445 Records, and Manual of Geology of India (in part).

During his whole service of 33 years in India, he never had any furlough. He was not absent from duty for a single working season, and never spent a single hot season in the hills.

WE are requested to announce that it is not intended to hold a Naval and Colonial Engineering Exhibition this year.

THEIR Royal Highnesses the Prince and Princess of Wales opened the Jubilee Exhibition at Manchester on the 3rd instant.

H. E. the Governor has been pleased to appoint A. F. Ayre, Esq., to act as Superintendent of Works and Surveys, Singapore, from the 9th instant, on which date he returned from leave of absence.

THE Victorian Government has taken into consideration a communication which has been received reporting the formation of the Pacific Telegraph Company (Limited), and inviting the co-operation of the Australasian governments in establishing cable communication between England and Australasia by way of the Atlantic, Canada, and the Pacific.

WE learn that the managers of the Royal Institution have accepted with the deepest regret the resignation by Professor Tyndall of the Chair of Natural Philosophy, to which he was elected in the year 1853, when he became a colleague of his friend the illustrious Faraday. Lord Rayleigh has been nominated for election as Professor of Natural Philosophy in succession to Professor Tyndall.

THE following items of army news have come by the last mail:—An order has been received at the School of Military Engineering, Chatham, for the augmentation of the Corps of Royal Engineers by two additional field companies. As soon as these companies have been completed the necessary arrangements will be made to form a third additional field company and also to create a forest company in place of the 11th Company.

THE MADRAS HARBOUR.

Its Construction, Destruction and Reconstruction.

IX.

A contributing cause of the disaster was the very unsatisfactory nature of the rubble base. In the articles published in the *Englishman* in January 1882, and with not very full information before him, the present writer said:—

"Even if no actual scour or erosion occurred, two other causes of failure of the rubble base seem possible. The first is bad material. The rubble is said to have been chiefly laterite. Low-level laterite, as found near Madras, is a stone of recent formation and very unhomogeneous composition. It is a porous argillaceous rock, much impregnated with peroxide of iron, which is irregularly distributed throughout the mass. There is often much pale yellow or white clay in it, containing little or no iron, and this is liable to be washed away on exposure. The iron is often in nodules, which leave holes when they get washed out. And there are sometimes horizontal cracks, which sometimes expand into small cavities. The rock, when first quarried, is so soft that it can easily be cut with a pick, and some times even with a spade, but it hardens greatly on exposure. But the exposed surface is always honeycombed, and is therefore liable to be crushed. Even supposing this laterite rubble were exposed till it hardened before being tipped into the sea, or that it hardens in, and resists the action of sea water, hardness is not necessarily strength, and a bed of this questionable material, with even a very wide base, of only 24 feet in thickness, might seriously crumble and yield under the pressure of a solid mass of concrete, which weighs 140 lbs. to the cubic foot, and of an enormous weight of water, the effect of which is intensified in a storm by the impact of the waves. Any unequal settlement of the laterite rubble bed under the solid concrete pier, which weighs 111 tons per running foot, and has a bearing of only 24 feet* in width on the rubble, would be fatal to the whole structure. This, then—concentrated weight on a narrow bearing—is the second possible cause of the failure of the rubble bed.

In his Report of 1st March 1882, Mr. Molesworth gave the following particulars of the materials used in constructing the rubble base of the different portions of the piers, and of the settlement which occurred during their construction:—

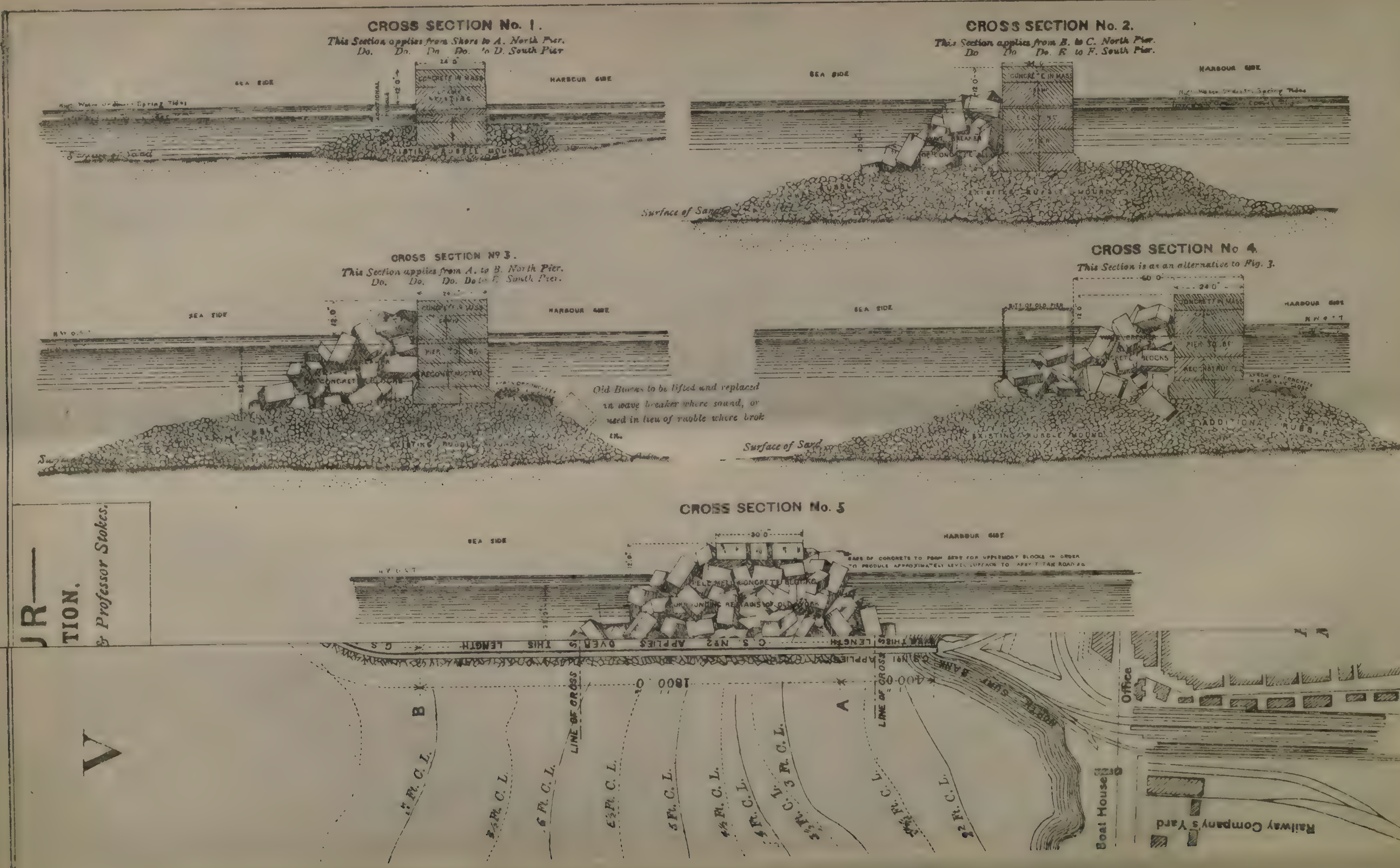
"The size of the stones of which the rubble base is composed, varies from 5 lbs. to 2 cwt. The rubble base is composed partly of quartzose gneiss and partly of laterite. The side of the south pier is chiefly formed of stone, whilst that of the north side of exceedingly good laterite. Unfortunately the quarry from which this laterite was obtained was exhausted, and the laterite obtained from the new quarry is by no means equal to that obtained from the original quarry. The elbows and faces of both piers are formed principally of laterite from the new quarry, but supplemented occasionally with a variable admixture of quartzose gneiss. The specific gravity of the quartzose gneiss is 2·7, which after allowing for interstices, would give a weight of 6½ tons per 100 cubic feet of rubble in position. The specific gravity of the laterite is about 2·4, that of the sand on which the rubble base rested is 2·1, whilst the specific gravity of the concrete block is about 2·3. I had several of the blocks of granite and laterite broken by the sledge hammer. The laterite from the original quarry, though softer, was more tough than the gneiss, and it usually required two, and sometimes more, blows to break a small block, whilst a single blow sufficed to break a gneiss block of the same size. An Eurasian overseer was stationed at the quarry to check the character of the laterite sent on to the works, but notwithstanding the fact that a considerable quantity was rejected, there is no doubt that laterite not equal to that obtained from the original quarry has been used in the work. The settlement of the work over the rubble base has varied. Over the gneiss the settlement was extremely small, and in some instances no allowance was made for settlement when pitching the blocks. The average settlement of work over laterite obtained from the original quarry was about 18 inches, whilst that on the laterite procured from the new quarry averaged about 3 feet, and in one case was about 4 feet. The blocks were laid in position by a titan, or large travelling crane with overhanging arm, and the principal settlement took place when, or soon after, the weight of the titan was brought on to the blocks."

In the summary of his opinions given towards the end of his report, Mr. Molesworth says,—"some of the laterite obtained from the new quarry is unsuitable for the rubble base, and I advise that no laterite be used in reconstruction." But he immediately adds—"I am of opinion that the failure of the breakwater is not attributable to the character of the concrete or laterite, though in some few parts the catastrophe may have been hastened by broken blocks or unsuitable rubble." This is quite inconsistent with an opinion previously expressed that—"the elbows have failed, on the seaside, from underscour of the rubble base." The scour must have occurred because the rubble was too small, or friable, and the rubble under the elbows was chiefly laterite, from the new quarry, the pieces weighing from 2 cwt. down to 5 lbs. Here, then, the catastrophe was not merely hastened, but directly caused by the character of the laterite rubble.

Regarding the quality of the rubble, Mr. Parkes said in his report on the failure, dated 9th March 1882, that though undoubtedly laterite was a *troublesome* material, and therefore he was glad to think that no more of it would be required—(why, does not appear), there was not the slightest ground for thinking that it contributed in any way to the disaster. "The trouble it occasions is that, being friable, it is very quickly compressed by the weight of the blocks laid upon it, so that to allow for subsidence the latter have to be set at a higher level than is ultimately required." And during settlement the concrete blocks got broken. "But when once consolidated, the laterite forms as good a bed as the granite rubble. This is proved by the comparison of the amount of settlement of the standing portions of the two piers, one being built on laterite and the other on granite. There is no appreciable difference between the two. It is right to add that the laterite was used, not from choice, but because it was not practicable to obtain the granite rubble in sufficient quantity to carry on the work at the speed for which all other parts of the work were organised. It would, of course, have been right to sacrifice speed of execution if ultimate stability were endangered, but after full consideration it was decided that this was not the case." The breaking of the concrete blocks occurred, Mr. Parkes says, over both the granite and laterite bases, and he argues that it did no harm, as the pieces got jammed tight in the process, and there was no evidence to show that the breakages contributed in any way to the failure of the work. And he considers the subsidence of the work under the action of the storm no evidence of weakness, but rather a substantial advantage.

We must now endeavour to state what Mr. Parkes appears to consider the causes of the failure of his work. The *first* cause was the insufficient depth below water-level of the crest of the rubble base, or, as Mr. Parkes would put it, the insufficient depth at which the superstructure was founded. He says it had been proved by the general practice of engineers at home that a depth of 15 feet below water is safe. At Wick the foundation at 18 feet depth was untouched, and no action was found below 10 feet. The deepest foundations he ever heard of being undermined were 11 feet below low-water at the Tyne, but at Madras the walls were in two places for a short length *undermined* at 22 feet below low-water. And a rather heavier sea would have produced a serious amount of damage. "The most important lesson taught by that storm is that *foundations at a depth of 22 feet under water are not proof against a cyclone sea.*" Mr. Parkes seems to have forgotten that this lesson had previously been taught him by the heavy sea of November 1880, when the scour round the end of his north pier in 22 feet of water undermined the blocks and let them down about 3 feet, *vide* the extract from his report of 14th January 1881. and sketch C given in our Article VI., p. 197. But, *second*, "the great bulk of the damage, however, is of a totally different kind, and is due to the direct force of the waves on the superstructure. The results produced are precisely what might have been anticipated in a work of insufficient strength. The impact of the sea was delivered to all appearance just where it was expected, but it was stronger than any we had previously experienced in this description of work, and required a greater resistance than we had provided. I believe the damage produced by this storm on the Madras Harbour Works is greater in its extent than that of any similar disaster on record, but it must not be concluded that this is due to an unusual degree of weakness in the work." The next sentence is one that might have been written by Mr. Gladstone himself:—"It is due rather to the fact that at Madras the maximum force of sea is not, as is practically the case on the coasts where most of our experience has been gained, an event of almost annual occurrence, but it occurs only at intervals of several years, and in one such interval of more than usual duration a great extent of work had been completed, and was therefore exposed at once to the previously unknown destructive action

* This should have been 28 feet.



CROSS SECTION No. 1.
This Section applies from Shore to A. North Pier.
Do. Do. Do. Do. to D. South Pier
SEA SIDE
HARBOUR SIDE
CONCRETE IN MASS
Surface of Sand
CROSS SECTION No. 2.
This Section applies from B. to C. North Pier.
Do Do Do. E to F. South Pier.
SEA SIDE
HARBOUR SIDE
CONCRETE IN MASS
Surface of Sand
CROSS SECTION No 3.
This Section applies from A. to B. North Pier.
Do. Do. Do. Do. to E. South Pier.
SEA SIDE
HARBOUR SIDE
Old Blocks to be lifted and replaced in wave breaker where sound, or used in lieu of rubble where brok
CROSS SECTION No 4.
This Section is as an alternative to Fig. 3.
SEA SIDE
HARBOUR SIDE
Surface of Sand
CROSS SECTION No. 5
SEA SIDE
HARBOUR SIDE
JR—
TION.
& Professor Stokes.
V
C.S. No 2 APPLIES OVER THIS LENGTH
C.S. No 1 APPLIES OVER THIS LENGTH
LINE OF CROSS S.
1800 0
400 0
B
A
7 Ft. C. L.
6 Ft. C. L.
5 Ft. C. L.
4 Ft. C. L.
3 Ft. C. L.
2 Ft. C. L.
Boat House
Office
Railway Company's Yard

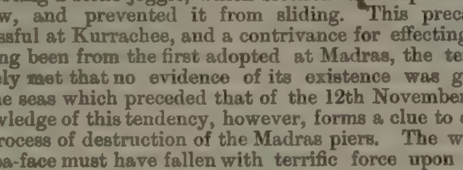
of a sea of nearly maximum force." In other words, Mr. Parkes designed his piers without any reference to what the force of the sea was known to be, or to what it might possibly prove to be at Madras, and though before the expiry of the year in which his design was made the signal warning at Wick was given, and even before that in May of that year, 1872, the extraordinary cyclone had occurred at Madras, with a velocity of wind of 53 miles an hour, during which the sea broke in the offing in 9 fathoms, he failed to take alarm, and left his design as it was, and this he did deliberately. His own statement has already been quoted in previous articles, on page 197 of this Journal. "It will be easily understood that these extraordinary occurrences were matters of deep interest to engineers connected with marine works. When the particulars became known to me, the breakwater at Kurrachee, 24 feet wide, had been completed, and those at Madras had been sanctioned for execution." (The Wick phenomenon occurred in December 1872: Mr. Parkes' Note, containing his proposal for a harbour at Madras was "put forward" in August 1872; Mr. Parkes was sent to Madras to report in September 1873, and his report is dated 4th November 1873: the Secretary of State's despatch sanctioning the works is dated 11th March 1875, and the works were not begun till December 1876.) Are we to understand that the occurrence at Wick did not become known to Mr. Parkes until after the 11th March 1875, or merely that he had not taken the trouble to ascertain the particulars of it. "I carefully reviewed the bases of my own conclusion with this new fact before me, but I soon found that an indiscriminating application of the lesson would condemn, not only these works, but many others which have stood the test of many years' experience, and I ultimately saw no reason to alter my own designs." He then refers to the failure of his Kurrachee foundation, which resulted in the complete overthrow of the harbour side wall for a length of 80 feet, leaving the sea side wall consisting of a single row of blocks standing 12 feet wide without any support throughout the rest of the monsoon. This "direct proof that 24 feet was more than enough at Kurrachee, seemed to outweigh any indirect conclusion from the unprecedented occurrence at Wick." *Quem Deus vult perdere, prius dementat!*

Writing before the plan and sections—Plate V—submitted by Mr. Beardsmore in the following July had made much progress, Mr. Parkes thus generalised as to the dynamic action of the sea on the superstructure of his work:—

"The experience gained at Kurrachee was to the effect that the heaviest blow of the sea was delivered on the tops of the blocks on the harbour side of the breakwater, tending to drive them out from the wall into the harbour. Several blocks were forced out in this way, but in no case was any block forced to seaward. The tendency was met by inserting a stone joggle, which blocked the top course to the course below, and prevented it from sliding. This precaution was quite successful at Kurrachee, and a contrivance for effecting the same object having been from the first adopted at Madras, the tendency was so completely met that no evidence of its existence was given by the action of the seas which preceded that of the 12th November last.

"A knowledge of this tendency, however, forms a clue to enable us to trace the process of destruction of the Madras piers. The waves rising upon the sea-face must have fallen with terrific force upon the top of the work on the harbour side, and the blocks were tilted off; * probably two courses, and possibly, in some cases, three courses, being displayed at once. The sea wall then standing alone yielded to the lateral force of the waves, and generally one course, but sometimes two, and in one or two cases even three, courses were driven after the blocks of the harbour wall. Generally speaking, there is a course more remaining on the sea side than on the harbour side.

"The following may be taken as a typical section of very much of the work in its present state:—



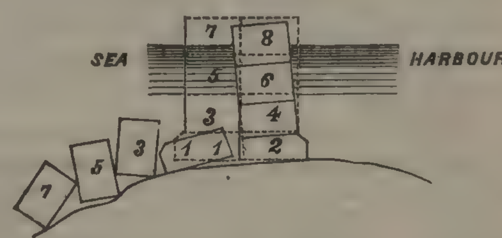
* If the top courses were blocked to the courses below, as just above stated, how came they to be tilted off? Being tapered upwards the joggles were of no use against a downward blow on the harbour edge of the upper block, and of only imperfect use against a lateral blow from outside.

"Parts of it are necessarily hypothetical, but there is enough which is matter of actual observations to justify the assumption of the remainder."

Mr. Parkes said there was sufficient evidence, direct and indirect, to negative the very improbable supposition that the inner or harbour end of blocks had been overthrown by undermining. But if this were correct it not only emphasized the insufficiency of the weight of his blocks, but brought into prominence the defect in his design, which was the insufficient height above water for a vertically-shaped structure. Had these blocks stood higher above water, the downward blow of the waves on them would have had less force.

Mr. Parkes continued:

"The above description may be taken as a generalisation of the effects produced upon about two-thirds of the damaged parts. It comprises the outer portions of the two piers, a length of 1,200 feet of the north and 900 feet of the south pier. The remaining third, comprising 400 feet of the north and 500 feet of the south pier, have been differently affected, and the investigation is more difficult, as the blocks are thrown down on both sides of the piers, and a precise examination of the portions which remain standing is for the most part impracticable. There is, however, one portion of the north pier, just at the commencement of the curve, which is accessible to the diver, and has been carefully examined. The following section made from his description* will very clearly exhibit the action to which it has been subjected. In this case the harbour wall is standing, though considerably damaged.



"No. 1 block is drawn out to seaward 4 feet from its original position, and its inner end is lifted 9 inches from the rubble bed, the block itself being tilted towards the sea. The upper blocks are lying in confusion on the sea slope of the rubble. I do not see how it is possible to attribute these results to any other action than undermining of the foundation blocks. The portion of the pier where this is evident is a length of something under 100 feet, but it is probable that whenever the upper blocks have fallen to seaward, it is due to the same cause, although the foundation blocks themselves are inaccessible. The action of the sea appears to have been exceptionally severe at this spot, for the original sandy bottom is scoured away 6 or 7 feet outside the rubble.

"There is a portion of the south pier, also on the curve, which appears to have been acted upon in a very similar manner."

Commenting on Mr. Parkes' report, but with the advantage of having Mr. Beardsmore's sections before him, given with this article Plate No. V, Colonel Sankey, in a note dated 26th July 1882, said:—

"On the positions of the lower blocks as thus determined, Mr. Parkes has based his reconstruction scheme on the monolithic system. It is unnecessary at this moment to make any very detailed analysis of the sections as now submitted by Mr. Beardsmore, the more so as the further sections promised later in the year will doubtless give the best continuous record which it is possible to obtain; but one can hardly examine those now furnished without being struck by the very much greater displacement of all the blocks, along both the seaward arms of the work, than one would be led to expect from Mr. Parkes' report.

"It is true there was, later in the year, rather a heavy sea, but Mr. Beardsmore has distinctly reported that this occasioned no further displacement of the blocks.

"Along the south pier, with the exception of the sections taken severally at 3,800, 3,775, 3,750, and 3,725 feet, the disturbance of all the blocks seems very great. Everywhere the piers seem to have shifted towards the harbour and sunk with a tilt in that direction, showing that where the two lower blocks Nos. 1 and 2 are not actually displaced they have no longer a horizontal bed as indicated by Mr. Parkes' section.

"Along the north pier the evidence of disturbance is even greater. The sections taken at 3,850, 3,775, and 3,350 feet, alone seem to hold out a hope that the lower blocks are sufficiently unmoved to build upon again.

"Everywhere there has been great settlement of the work on a whole, and dragging seaward of the rubble base, coupled with other evidence confirmatory of Mr. Molesworth's opinion that the random block system of reconstruction seems the only safe one now to resort to.

"However this may be, there would seem to be sufficient evidence in the sections now submitted to warrant delay in adopting Mr. Parkes' monolithic system of reconstruction till they have come under the notice of the home experts, who, no doubt, will be consulted by the Secretary of State."

* Mr. Parkes does not appear to have donned the diving dress, as Mr. Molesworth did, and personally explored the ruins below water.

REPORT ON THE PREVENTION OF THE WASTE OF WATER.

By S. Tomlinson, Assoc. M. Inst. C.E., F. R. Met. Soc., Deputy Executive Engineer, Water Works, Bombay.

I.

The following observations on the water-supply of the city, with special reference to the prevention of the waste of water, are submitted for consideration:—

2. The whole supply from the Vehar and Tulsi Lakes is distributed through three main divisions:—

(1) The water brought by the 32″ main from Vehar to Bhandarwada Reservoir afterwards leaves that Reservoir by a 48″ main and supplies the very densely-populated district bounded approximately by Bellasis Road, Khetwadi, Kalbadevi, Carnac Road, Navroji and Bhandarwada Hills, and Nesbit Road.

(2) The new 24″ main from Vehar supplying the northern portions of the Island (with Bandora and Kurla) as far south as Bellasis Road and Nesbit Road. To this main there is no service reservoir. Any surplus water joins the 32″ main at Nesbit Road on its way to Bhandarwada Reservoir and supplements that supply.

(3) The water derived from the Tulsi Lake is received into the Malabar Hill Reservoir and afterwards distributed, partly by pumping, to Malabar and Khambala Hills, and partly by gravitation, to Chowpati, Girgam, Dhobi Talao, North and South Fort, Frere Road District, and Colaba.

3. In the first-named (Bhandarwada) district, so far as can be determined under existing circumstances, 8¼ million gallons per day are distributed. The population of the district is 520,000. The number of gallons per head per day is, therefore, about 16. This quantity of water is supplied in 7 hours out of each 24,—*i.e.*, from 5 to 9 A.M., and from 4 to 7 P.M., and the rate of consumption during this time is about 1,180,000 gallons per hour.

4. The natural consequence of this method of supply is, that the pressure on the mains is very much below the theoretical pressure due to the difference of level between any main and the reservoir. This want of pressure involves in many cases the use of two connections for one property, one being for the upper floors only, without which no water at all is received there. It has also led to the granting of ferrules and pipes of such large sizes that the total supply required in a house for a day could be drawn in a few minutes. In most cases, as shown by the diagrams taken, the present supply, both morning and evening, is cut off whilst the consumption is at its full height. This means that many taps are open and will remain open until the water is again turned on. It is a matter of daily experience that taps are found from this cause running water to waste, sometimes with no vessel underneath, sometimes with a vessel filled and overflowing. The mischief, however, is not confined to this visible waste of water. Twice every day the mains become charged with air instead of water. When the water is again turned on, this air is liable in many situations to become compressed and very destructive to the pipes and fittings, causing many leakages in places not easily discovered. The air drawn into these pipes comes in many instances from places not likely to contribute to the quality of the water being improved. The same remark as to contamination also applies to water which, under this intermittent system, is stored in chatties or other vessels from morning to evening or evening to morning. The benefits to be derived from the filtration-works already provided for this district are thereby greatly minimized.

5. An intermittent supply such as is given to this district is therefore the worst supply that can be given through pipes. It leads to visible leakage due to negligence; to invisible leakage due to bursts; and to deterioration in the quality of the water.

6. In the second district (24″ Vehar main) the supply was until July also generally intermittent, but it was distributed through more hours, averaging about 8. But in order to save the water which would have been wasted in the remaining hours, the services of nine men were engaged in shutting and opening the sluices at the fixed hours. There are no exact means of estimating what quantity of water actually passes out of the Vehar Lake into this main. From approximate calculations, however, it appears the supply is probably about 1,500,000 gallons per day and the population 80,000, equal to 19 gallons per head per day.

7. In the Tulsi district there is a population of 170,000, and the quantity supplied is 5 million gallons per day. This gives nearly 30 gallons per head per day for the whole population. The district is supplied on the intermittent system; the hours were about 9 per 24 except for the higher parts of Malabar and Khambala Hills, which were supplied from 4 to 5 hours per day only. The pressure in this district is higher (55 lbs. against 30 lbs.) than in the Vehar district, and the damage caused to mains, services and fittings by recharging is proportionately increased. Much inconvenience and loss has been caused in each district on the occurrence of fire from the delay in receiving a supply of water and the same remark applies to the shipping in the different docks.

8. If from the quantities of water supplied as stated above are deducted the quantities supplied by meter, we arrive at the quantity supplied for domestic purposes, road watering, and waste. The average quantities per day supplied by meters in the three districts were, for the year 1885-86, as follow:—

	Total.	Meter Supplies.	Balance.
1st.—Bhandarwada...	8,250,000	550,000	7,700,000
2nd.—24″ Vehar Main	1,500,000	790,000	710,000
3rd.—Tulsi ...	5,000,000	400,000	4,600,000
Gallons per day	14,750,000	1,740,000	13,010,000

From these figures it will be seen that the quantity of water supplied by meter, which yields half the total revenue, is a very small proportion—one-eight—of the whole supply.

(To be continued.)

MYSORE PROVINCE.

(From our own Correspondent.)

From a professional point of view matters in the province are looking brisk, and the marked progress in the D. P. Works may safely be placed to the credit of Lieutenant-Colonel Bowen, R.E., who as head of the Department appears to be the right man in the right place. Recently this officer made an extended tour in the districts and brought some of the sleepy ones to task, while it is said he has noted a heap of things that have got to be done. In the course of one inspection Colonel Bowen noted the dilapidated and unsightly condition of a large number of tunnels and bridges along the various roads traversed by him, and pointed out that while the whole of the allotments were spent on the efficient maintenance of the surface of roads little or nothing was reserved for masonry repairs, and ordered that such a state of affairs must be remedied by setting aside a small portion of the road grant for repairing and making good the parapets, wings and cornices of all bridges and tunnels—to take effect with the official year. The absence of stacked metal along each furlong of road for petty repairs also called for special remark, and all Executive Engineers have been told it is their duty to see that in addition to the stacks of metal collected in advance for special recoats, a sufficiency of material is stacked all along the roads at convenient intervals, for ordinary maintenance repairs and that such stacks should be replenished as they became exhausted. These orders come just in time, as with the advent of the rains—about May or June—fine opportunities will be afforded for carrying out repairs to roads.

In the D. P. W. it is expected that Captain C. H. M. Kensington, R.E., on return from furlough, will come back to this Province to serve under the Mysore Durbar; in what capacity it is not understood, for though Colonel Bowen was brought in only on the departure of Captain Kensington on leave, last year, yet it was understood that the former officer would not

submit to any temporary arrangement and took permanent charge of the D. P. W. under the Durbar, while the services of Captain Kensington were transfered to the Madras Government. It is also said that Messrs. McLaughlin, C.E., and McHutchin, C.E., are about to leave the Service here, they having been transferred to the British Service; both these officers have put in all their service in the Mysore Provinces—the former having joined as an Apprentice Engineer from Roorkee.

A block of offices are about being constructed at Mysore for the Dewan, and competition for designs was invited from among the members of the D. P. W. The Committee awarded the prize of Rs. 500 to Mr. R. Scaldwell, Executive Engineer, Palace Division. This officer met with a very severe accident a short time back, being thrown by his horse and fracturing his skull in the fall, but he is out of danger and improving rapidly.

The S. M. Railway is about to start work on the extension of the line, through the province, from Gubbi to Hurryhar, and it is high time they did. The Company took over the State lines in July last, and had all the surveys and working plans given to them. so that the cause of delay is not apparent. By this time all the heavy banks and cuttings ought to have been progressed with, while material for bridges ought to be on sites. The great bridge on this extension will be the one over the Tungabudra River, which forms the boundary between the Mysore country and the Dharwar district of the Bombay Presidency. There exists a splendid masonry arch bridge over this river built by the Mysore Government, under the superintendence of the late Lieutenant-Colonel W. R. Johnston, on the high road passing out of the province; but though this bridge would have been utilised for the Railway had the State lines remained in the hands of the Durbar, I doubt whether the Mysore Government will allow its being so utilised by the S. M. Railway.

It is sad to record a serious accident on the Mysore State line a short time back which resulted in the death of the driver and two firemen, but it is something to add that it is the *first* accident which has occurred since the line was opened for traffic, about 6 years ago. This says a good deal for the responsible officers, and it was with much regret that all saw here, a most unfounded and unprovoked attack in the columns of a Madras paper on Mr. Molloy, who is in charge of the line; though the amends was subsequently made by the same journal.

The increase in the traffic of the Mysore lines is a matter for congratulation. For the past year traffic has steadily increased, so much so that it was anticipated there would have been upwards of *6* per cent. of a return had not the accident referred to above caused loss by damage of rolling stock. But the full benefits of the traffic will not accrue till the Mysore country is connected by the through line with S. M. system of railways in the Bombay Presidency. When this is accomplished the traffic that will go along this line—Bangalore to Poona, *via* Tumkur, Hurryhar and Dharwar,—will, no doubt, affect the returns on the Bangalore Branch of the Madras Railway.

After a good deal of correspondence and agitation the Madras Railway people have grasped the fact that the inconveniences to the various gold mining companies at work on the Kolar gold fields, from the want of efficient and sufficient transport accommodation at the Railway stations of Kolar Road and Kamasundra, are based upon good grounds. One has only to take a glance at the confusion evident all over the Kolar Road station to note that the arrangements of the Railway are such that would not be tolerated out of India. The traffic in goods for the gold mines is something enormous and beyond the ordinary goods sheds and a siding of rails and a lay by nothing exists to faciltate unloading and despatching. No one is surprised at this state of affairs, for it is a notorious fact that the Madras Railway does as little as it can for the convenience of the public, and at many stations corruption is so rampant that merchants prefer the old dâk road and the common cart to transport their goods.

The M. R. bureax are now, as I said, making great improvements both at Kolar Road and Kamasundra. In the opinion of those best able to judge the latter station is the more important of the two—though far behind Kolar Road at present—as it is the nearest to several gold mines, and when the Mysore D. P. W. constructs the road in contemplation from Kamasundra to Ooregan fields, then the most of the traffic to the mines will move *viâ* Kamasundra.

April 22, 1887.

NOTES FROM HOME.

(*By our own Correspondent.*)

After an inquiry of five days a Select Committee of the House of Commons have passed the Bill promoted by the City of London and Southwark Subway Company for an extension of their authorized line from the Elephant and Castle through Kennington under Clapham Road to the Swan at Stockwell. The estimated cost of construction will be about £200,000 per mile.

The Ambleside Railway Bill has been thrown out; the financial prospects of the undertaking having, it is understood, principally weighed in this decision of the Committee. The sacredness of the Lake District will thus, at least for a time, be left unmolested by the invasion of the locomotive.

Another attempt is to be made to raise the six millions necessary for the construction of the Manchester Ship Canal by first appealing to the districts concerned, and, it is hoped, by this means to raise one half of the required capital. London financiers are not over-sanguine of the result, and the success will greatly depend upon how the scheme is supported by the appeal to those who will reap the immediate benefit. Unless the money is raised before 6th August next the powers to construct the canal will lapse.

The North Eastern Railway have recently completed an examination of the vision of its drivers on its northern division, and out of nearly a thousand only about a dozen were found to have more or less defective sight, and they have accordingly been suspended. The tests applied and the *modus operandi* of the examination do not transpire.

A paper on the Railways and the Development of India was recently read before the East India Association by Mr. J. S. Jeans in the presence of Lord Granville and many gentlemen connected with our Indian administration. The author compared railway enterprise in other dependencies of the British Empire with that of India, where it is shackled with the sanction of Downing Street. The influence of railways in saving the inhabitants of India from risks of famine was considered, and the author dealt with the benefits to the industries of India as resulting from the development of railways and pointed to the necessity, not only of building new railways, but of affording better facilities and lower freights on the railways already in existence.

Scientific Iron-founding is the title of a practical paper read before the South Staffordshire Institution at their last meeting. In this paper special reference is made to chemical composition and mechanical testing. On the subject of founding I would draw the attention of your readers to a valuable series of articles, which, with the accompanying illustrations on pipe-founding, is given in this and previous weeks' "Industries."

The struggle between guns and defences still goes on. Major Schuman has invented a system of disappearing turrets, and this has been improved upon by Major Mongin, who devises a mushroom-shaped dome, which its immunity from damage enables to be constructed of thin defensive armour. This turret is caused to disappear by suitable hydraulic appliances, and it would, therefore, be exposed to the fire of the enemy only at short intervals of time. The weakness of this invention appears to be in its being a very complicated and delicate piece of mechanism. But these improvements serve to point out more and more that warfare for the future becomes the business of the engineer quite as much as that of the soldier or the sailor.

By means of the use of turn screws, a torpedo boat lately built by Messrs Yarrow and Co., of Poplar, for the Italian Government, has at her trial trip attained a speed of 27 knots an hour or a mean of 25 knots or 28 miles per hour, and is therefore the fastest boat in the world.

For the last two weeks the House of Lords' Committee has been occupied in considering two Bills respecting the water-supply, which has attracted the greatest amount of interest among engineers, scientific experts and Municipal authorities. One of these Bills is promoted by the existing Company, and the other by the Corporation. The existing Company owing to the non-realization of the expected increase of population, seeks authority to continue a certain increase of rates authorized in 1864 for 25 years to construct additional works and raise £100,000 for the purpose. The object of the Corporation is to compulsorily purchase the Company's undertaking. A very spirited contest has been going on, in which Mr. Hawksley and other prominent Civil Engineers have given important and interesting evidence.

The last ordinary meeting of the Institution was occupied in the discussion of Colonel E. Maitland's paper on "The Treatment of Gun-steel" and which stands further adjourned to the next meeting.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Bombay, April 28, 1887.

Mr. Vishnu Vithal Gole, L.C.E., is appointed Assistant Engineer, 3rd grade, with effect from the 31st March 1887, on which date he completed one year's probation as apprentice.

Madras, April 26, 1887.

The following appointment is made :—

Colonel H. Smalley, R.E., Executive Engineer, 1st grade, to hold charge of the Chinglepnt Division in addition to the North Arcot Division, during the absence on privilege leave of Captain L. Langley, R.E.

The following transfers are ordered :—

Mr. A. M. Hayes, Executive Engineer, 4th grade, temporary rank, from the VI. Circle, Tinnevelly Division, to the V. Circle, Chingleput Division, for charge of No. II. Party, Tank Maintenance Scheme. To join on return from leave.

Rai Bahadur S. Gopala Krishna Aiyar, B.C.E., Assistant Engineer, 1st grade, from the VI. Circle, Madura Division, to the III. Circle, Kurnool Division. To join at the public expense.

Mr. W. C. DeMorgan, Executive Engineer, 3rd grade, from the II. Circle, Kistna Eastern Division, to the I. Circle, for charge of the Godavari Western Division. To join at the public expense.

The following postings are ordered :—

Rai Bahadur S. Subbarayachariyar, B.C.E., Executive Engineer, 4th grade, to the IV. Circle, Coimbatore Division, for charge of No. IV. Party, Tank Maintenance Scheme. To join on relief by Captain O. V. Boddy, R.E.

Mr. C. H. T. Norfor, Executive Engineer, 3rd grade, to the III. Circle, Kurnool Division, for charge of No. III. Party, Tank Maintenance Scheme. To join on return from furlough.

Mr. J. M. Bell, Executive Engineer, 2nd grade, to the VI. Circle, Madura Division, for charge of No. I. Party, Tank Maintenance Scheme. To join on return from furlough.

The following promotions are made :—

Mr. J. J. Whiteley, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 8th February 1887.

Mr. J. H. Medlicott, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 20th March 1887.

Rai Bahadur S. Gopala Krishna Aiyar, B.C.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 1st April 1887.

Mr. A. T. Mackenzie, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 1st February 1887.

N.-W. P and Oudh, April 30, 1887.

Buildings and Roads Branch.

With reference to Notification, dated 19th October 1886. Mr. J. Adam, Assistant Engineer, 2nd grade, joined the Kumaun Division, Provincial Works, on the afternoon of 18th March, and with reference to Government of India, Public Works Department Notification, dated 17th idem, transferring him to State Railways, he was relieved of his duties in these Provinces on the forenoon of the 17th April.

Irrigation Branch.

With reference to Notification dated 19th April 1887, reposting him to the 2nd Circle Irrigation Works, Mr. E. W. S. Douglas, Executive Engineer, 3rd grade, is posted to the Cawnpore Division, Lower Ganges Canal.

With reference to Government of India, Public Works Department, Notification dated 23rd April 1887, placing his services at the disposal of the Home Department, for employment on probation in Burmah, Mr. S. P. H. Dyson, Assistant Engineer, 1st grade, sub. *pro tem.*, was relieved of his duties in these Provinces on the afternoon of the 5th April 1887.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner of Oudh, is pleased to order the following promotions, with effect from the dates specified :—

Mr. A. M. Fagan, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, from 6th March 1887 *vice* Babu Jogindro Nath Mukerjee on furlough.

Mr. W. B. Gordon, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, from 9th March 1887, *vice* Major Corbett, R.E., promoted to temporary Superintending Engineer.

The temporary promotion of Mr. A. M. Fagan to Executive Engineer, 4th grade, from 9th March 1887, notified on 18th idem 1887, is cancelled.

Mr G. T. Oliver, Assistant Engineer, 1st grade, is transferred from the Cawnpore to the Narora Division, Lower Ganges Canal.

India, April 30, 1887.

Mr R, B. Buckley, Executive Engineer, 1st grade, Bengal, is appointed Under-Secretary to the Government of India in the Public Works Department, *vice* Major G. F. L. Marshall, R.E.

The undermentioned passed students of the Thomason College are appointed to the Public Works Department as Apprentice Engineers and posted as specified below :—

North-Western Provinces and Oudh.—Baboo Chandu Lall.

Punjab.—Mr. F. W. Schonemann and Mr. E. E. Taylor.

State Railways : —Baboo Bhupat Rai.

With reference to Public Works Department Notification of this date, Baboo Bhupat Rai, Apprentice Engineer, is posted to the Establishment under the Director-General of Railways.

The Governor-General in Council is pleased to order the following appointments :—

Colonel R. C. B. Pemberton, R.E., Director-General of Railways and Deputy Secretary to the Government of India, Public Works Department, to be Secretary to the Government of India in the Public Works Department, *vice* Major-General H. F. Hancock, R.E., deceased.

Lieutenant-Colonel L. Conway-Gordon, R.E., C.I.E., Director, North-Western Railway, to be Director-General of Railways and Deputy Secretary to the Government of India in the Public Works Department, *vice* Colonel R. C. B. Pemberton, R.E.

The services of the undermentioned officers are placed at the disposal of the Government of Madras for employment on the South Indian Railway :—

Mr. W. G. Gilchrist, Executive Engineer, 2nd grade, State Railways.

Mr. F. G. Brook-Fox, Executive Engineer, 3rd grade, Burmah.

Mr. W. Drew, Assistant Engineer, 1st grade, State Railways.

The Governor-General in Council is pleased to order the following promotions and reversions of Executive and Assistant Engineers attached to the several Local Administrations, with effect from the dates specified :—

A. Leventhorpe, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 21st September 1886.

W. G. Newton, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent rank, with effect from 14th October 1886.

F. Sharp, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 14th October 1886.

C. F. Gilbert, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent rank, with effect from 14th October 1886.

J. Wallace, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 14th October 1886.

Borah Bolinarayan, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 14th October 1886.

L. A. Light, Brijmohan Lall, Rai Saheb, Lieutenant W. R. Morton, R.E., Assistant Engineers, 2nd grade, to be Assistant Engineers, 1st grade, permament rank, with effect from 14th October 1886.

Borah Bolinarayan, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 30th October 1886.

Bholanath Dass, Rai Bahadur, Executive Engineer, 1st grade, sub. *pro tem.*, to be Executive Engineer, 1st grade, permanent rank, with effect from 30th October 1886.

C. E. Gael, Executive Engineer, 2nd grade, to be Executive Engineer, 1st grade, sub. *pro tem.*, with effect from 30th October 1886.

R. E. Nelson, Executive Engineer, 2nd grade, sub. *pro tem.*, to be Executive Engineer, 2nd grade, permanent rank, with effect from 30th October 1886.

G. S. T. Harris, Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 30th October 1886.

Captain J. C. Addison, R.E., Executive Engineer, 3rd grade, to be Executive Engineer, 2nd grade, sub. *pro tem.*, with effect from 30th October 1886.

J. Wallace, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, temporary rank, with effect from 31st October 1886.

A. Leventhorpe, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 31st October 1886.

W. Algie, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent rank, with effect from 5th November 1886.

C. C. B. Knapp, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 5th November 1886.

J. G. Wyatt, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent rank, with effect from 5th November 1886.

J. Wallace, Executive Engineer, 4th grade, temporary rank, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 5th November 1886.

A. Leventhorpe, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 5th November 1886.

A. Leventhorpe, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 12th November 1886.

E. J. Rumsby, Executive Engineer, 3rd grade, sub. *pro tem.*, to be Executive Engineer, 3rd grade, permanent rank, with effect from 16th November 1886.

T. H. Jewett, Executive Engineer, 4th grade, to be Executive Engineer, 3rd grade, sub. *pro tem.*, with effect from 16th November 1886.

G. G. White, Executive Engineer, 4th grade, sub. *pro tem.*, to be Executive Engineer, 4th grade, permanent rank, with effect from 16th November. 1886.

E. M. Sage, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 16th November 1886.

A. Leventhorpe, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 16th November 1886.

A. Leventhorpe, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 17th November 1886.

J. N. D. La Touche, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 17th November 1886.

I. Donnan, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, with effect from 20th December 1886.

Director-General of Railways.

Lala Babu Mal, Executive Engineer, 4th grade, temporary rank, is transferred, in the interests of the public service, from the Sind-Sagar State Railway to Toungoo-Mandalay Extension of the Burmah State Railway.

With reference to Public Works Department Notification, dated 7th April 1887, Lieutenant W. J. Bythell, R.E., Assistant Engineer 2nd grade, is posted to the Sind-Pishin State Railway, Northern Section.

Mr. G. P. Rose, Executive Engineer, 4th grade, temporary rank, is granted furlough for six months with the usual subsidiary leave with effect from the 15th April 1887, or such subsequent date as he may be permitted to avail himself of the same.

Military Works Department.

The following promotions and reversions are made in the Engineer Establishment of the Military Works Department, with effect from the dates specified :—

Lieutenant F. H. Kelly, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank with effect from 1st October 1886.

Lieutenant J. E. Dickie, R.E., Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 5th October 1886.

Lieutenant H. Mullaly, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 5th October 1886.

Lieutenant F. H. Kelly, R.E., Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 7th October 1886.

Lieutenant J. Stewart, R.E., Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, permanent rank, with effect from 11th October 1886.

Lieutenant R. T. Laurence, R.E., Assistant Engineer, 2nd grade, sub. *pro. tem.* to be Assistant Engineer, 2nd grade, permanent rank, with effect from 11th October 1886.

Captain G. M. Porter, R.E., Executive Engineer, 4th grade, sub. *pro. tem.* to be Executive Engineer, 3rd grade, sub. *pro. tem.*, with effect from 1st November 1886.

Captain F. Peel, R. E., Executive Engineer, 4th grade temporary rank, to be Executive Engineer, 4th grade, sub *pro. tem.*, with effect from 1st November 1886,

Lieutenant F. H. Kelly, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 1st November 1886,

Lieutenant J. M. Wade, R.E., Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, sub. *pro. tem.* with effect from 1st November 1886.

Lieutenant F. H. Kelly, R.E., Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 8th November 1886.

Lieutenant H. Mullaly, R.E., Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 24th November 1886.

Lieutenant H. Mullaly, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 7th December 1886.

Lieutenant H. Mullaly, R.E., Executive Engineer, 4th grade, temporary rank, to revert to Assistant Engineer, 1st grade, with effect from 14th December 1886.

Captain H. H. Hart, R.E., Executive Engineer, 4th grade, supernumerary, to be Executive Engineer, 3rd grade, permanent rank, with effect from 13th December 1886.

Lieutenant J. M. Wade, R.E., Assistant Engineer, 1st grade, sub. *pro. tem.*, to be Assistant Engineer, 1st grade, permanent rank, with effect from 7th January 1887.

Lieutenant T. F. B. Renny-Tailyour, R.E., Assistant Engineer, 2nd grade, to be Assistant Engineer, 1st grade, sub. *pro. tem.*, with effect from 7th January 1887.

Lieutenant H. Mullaly, R.E., Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, with effect from 20th February 1887.

Burmah, April 23, 1887.

Mr. A. desA. deCrettes, Executive Engineer, 2nd grade, reported his return from furlough on the forenoon of this date and is posted to the charge of the Henzada division.

With reference to *Burmah Gazette* Notification No. 56, dated the 12th April 1887, Mr. M. Birkbeck, Executive Engineer, 2nd grade, is granted 15 days' subsidiary leave from the date on which he is relieved of charge of the Henzada division.

Burmah State Railway.

Mr. A. J. Oldham, Executive Engineer, 2nd grade, reported his return from the privilege leave granted to him in this office Notification, Toungoo-Mandalay Extension, dated the 23rd ultimo, on the forenoon of the 18th instant.

Punjab, April 21, 1884.

Mr. J. Brabson is appointed to officiate as Assistant Secretary to Government, Punjab, in the Public Works Department.

Irrigation Branch.

Mr. H. V. S. Baker, Executive Engineer, 3rd grade, to the 2nd Division, Bari Doab Canal, which he joined on the 25th March 1887.

Mr. R. D. Bayley, Executive Engineer, 1st grade, Dera Ghazi Khan Division, Indus Canals, is allowed furlough for 12 months.

Central Provinces, April 30, 1887.

Rao Sahib Ishwari Prasad, B.A., Assistant Engineer, 3rd grade, is transferred from the Eastern to the Nagpur Division.

Mr. C. O. Leefe, Executive Engineer, 4th grade, on being relieved of the charge of the Hoshangabad Division, is attached to the Nagpur Division.

With reference to Notification dated 28th current, Rao Sahib Ishwari Prasad, B.A., Assistant Engineer, reported his arrival at Nagpur on forenoon of the 27th idem.

Bengal, May 4, 1887.

Establishment.

Mr. C. P. Warde, Assistant Engineer, Hazaribagh Division, is transferred as a temporary measure to the Balasore Division.

Establishment—Railway.

Mr. J. C. Mills, Assistant Engineer, 1st grade, Assam-Behar State Railway, passed the Departmental Standard Examination in Hindustani on the 26th April 1887.

Notices.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Answers to Correspondents.

WE have to state, in reply to various inquiries, that the account of the Auriferous Tracts of Mysore in these pages is the most recent and reliable extant.

INDIAN ENGINEERING.

SATURDAY, MAY 14, 1887.

HIGHER APPOINTMENTS IN THE PUBLIC WORKS DEPARTMENT.

THE *Englishman* in a recent issue, Monday, May 9th, contained a leader on the above subject. The article in question, however, states the case so unjustly to the Civil Engineers of the Department, that we cannot refrain from taking up the cudgels on their behalf, notwithstanding the fact that we have so frequently alluded in our recent numbers to the unfairness with which they, as a body, have been treated.

The *Englishman* commences its article by saying "the recent appointments to the senior posts in the P. W. D. have called forth certain not very intelligent criticisms on the alleged partiality of the Government in selecting Royal Engineer officers" for the same. The only paper which we know of to have indulged in such criticism is the *Civil and Military Gazette,* and we are quite certain that the general feeling of the Department is in favor of the recent appointments alluded to by the Calcutta paper. These are, we presume, the appointments of Colonel Pemberton, R.E., to be Secretary to the Government of India, and of Colonel Conway Gordon, R.E., to be Director-General of Railways. The former is generally approved on account of Colonel Pemberton's fitness and seniority in the service, but it must be admitted, that this is accentuated by the feeling of dismay, which arose at the time when it was generally feared that Colonel Filgate was to be the future head of the Department. This feeling at the time found expression, and in many cases forcible expression, in every paper of note in India; and it is quite a fact, that Colonel Pemberton's appointment was received with general satisfaction and a sense of relief. Colonel Conway Gordon's reputation for ability is so high, that any remark from us on the subject is uncalled for; and although many Civil Engineers would have been glad to see Mr. O'Callaghan Director-General of Railways, few of them will be heard cavilling at Colonel Gordon's appointment, inasmuch as the latter is the senior officer of the two, and thoroughly qualified for the post.

It would, however, be ridiculous to say that the Civil Engineers of the Department have no grievance or cause for complaint, and here we join issue at once with the *Englishman.* In many cases the seniority, and the position of the senior Royal Engineers on the list, is due to unfair promotion over the heads of their Civilian fellows; and what is still worse, they are too often manipulated like pieces on a chess board, and appointed from Branch to Branch, from province to province, irrespective of their qualifications or experience. A Royal Engineer officer, who has been all his life in the Accounts Branch or editing a Code, or repairing barracks, would, if the need arose to keep out a Civilian, be made a Chief Engineer anywhere, Secretary to the Government of

India, or Director-General of Railways, with a gaiety and promptitude that literally make one gasp again. We have known a Royal Engineer, who had never been on Railways in his life, except as a passenger, to be suddenly given charge of a large system of Railways, after which auspicious event, he was often heard to say, that it was quite unnecessary to reserve Railway appointments for Railway men, as the best men for the purpose were those who had had no previous experience of Railway work, because they were able to take up their work with unprejudiced and unbiassed minds! We can assure our readers that, ludicrous as the above may seem, it is perfectly true.

The Civil Engineer is, on the other hand, only promoted in that Branch of the service which he originally selects, and, unless he is a Railway man, only as a general rule in his own particular province. Then, when he is about the top of the tree in his province, a senior, or sometimes junior, Royal Engineer (from another province) is put over his head as Chief Engineer. After that, the unfortunate man generally retires in disgust, and takes his pension if he can afford to do so. As instances of the above we can quote the supersession of Mr. J. W. Wright in the Punjab by Colonel Steel, of Mr. Vertannes in Bengal by Colonel Harrison, the recent appointments of Major Marshall, a 3rd grade Superintending Engineer as Chief Engineer to the Central Provinces, and Major Gracey's appointment in Upper Burma. As regards Colonel Harrison's appointment in Bengal, we must remark, that Mr. Vertannes is eleven places above him on the list, and Mr. Rhind just one below him. Mr. Vertannes is a man of marked ability, and Mr. Rhind, in addition to being a most able officer, has written a work on river discharges, second in value only to the celebrated Mississippi report, which represents the labours and research of the most eminent American Hydraulicians expended over a period of several years. In spite of the fact of these two Superintending Engineers being on the Bengal list, it was considered necessary to import a comparatively junior Superintending Engineer from the North-West Provinces to rule Bengal Irrigation.

One more fact, and we have done. It will hardly be believed that since 1867, when the Irrigation Branch was formed, not one step has gone in Bengal on account of the promotion of a Superintending Engineer to Chief Engineer. Bengal, owing to its superior unhealthiness, has always been the happy hunting ground of the Civil Engineer. At present there are only three Royal Engineers in the Province, the Chief Engineer and Secretary, the Irrigation Chief Engineer, who is also Joint-Secretary, and the Senior Under-Secretary. In fact, Bengal has always been in the main officered by Civil Engineers, and has, therefore, served admirably for the purpose of providing Chief Engineerships for all the provinces of India. Beginning at 1867, and taking the Provincial side first, we have had the following Chief Engineers:—Colonel Nicolls, the perennial, a North-West officer, Colonel Cadell from Central India, Colonel Stanton from Railways, Colonel Trevor from Burmah, and Colonel Browne from Burmah. On the Irrigation side, we have had Colonel Rundall, a Madras man, Colonel Haig from the Central Provinces, Mr. Levinge from Bengal, Colonel McNeile from Assam, and Colonal H. Harrison from the North-West Provinces. A superficial observer would imagine that the Branch got at any rate a step for Mr. Levinge's appointment, but such was not the case. That promotion was swallowed up in the adjustments following the 1879 reductions. The Bengal Branch was once lucky enough to have a Royal Engineer Superintending Engineer (Colonel Smythe) transferred to Hyderabad, but rather than let the Civil Engineers get the promotion, a senior Superintending Engineer was promptly transferred to Bengal in his place. Is there any cause for wonder that there is discontent among Civil Engineers, when their more lucky R. E. brethren are given all the best appointments in every province, no matter where or in what Branch they have served before. If the history of the senior appointments in each province were given in detail, as we have given that of Bengal to-day, we believe that just cause for dissatisfaction would be found almost in every case; and that the *Englishman* would not have to find fault with the Civil Engineers for their "not very intelligent criticisms."

THE INDIAN JUTE INDUSTRY.

Better late than never would be an appropriate motto for the Indian Jute Manufacturers' Association to adopt. Taking into account the fact that the industries, in connection with that important article of commerce, have largely developed within the last decade or two, it is strange that the agents of the several mills should have so long abstained to combine for the protection of their common interests. They have, however, acted wisely in taking action in the matter, and a well-known Armenian gentleman, himself the moving power in a large concern, is to be congratulated on his successful efforts in organising an Association in the middle of 1884, with the help of some of the leading members of the mercantile community.

From the several reports of its operations before us we find that, although it made very little progress in the first six months, in course of time its sphere of usefulness has been increased and a great deal has been accomplished. The important questions which engaged its attention at the meeting of the 25th September 1885 were, the reduction of the manufacture of gunnies in the depressed state of the trade, the reduction of the wages of weavers and other native operatives, the opening out of new markets for jute manufactures, and the settlement of a form of contract for general adoption which should be equitable to all at the same time.

The first question was fully gone into, and it can hardly be denied that the present unhappy condition of the jute trade is, in great part, due to a want of combination among the agents and directors of the several mills. The majority

of the concerns were working at a dead loss, and so long as the prospects were not more cheering it was advisable that they should restrict the loss to as small a figure as possible. This could only be attained by curtailing or ceasing manufacture and not by continuing to work at full power, which, to an unprejudiced mind, would appear to be axiomatic. But, as we have said above, they ignored the principle that union is strength, and while a few are working short time, others have closed in expectation of better times reviving in the near future, when they would resume business on the former scale. And what has been the result of this isolated action ?—instead of any improvement being observed, matters have drifted from bad to worse, and something like a general dead-lock is the outcome.

Now, immediately connected with this question is the other one of reduction of wages, in which also it was found that unanimity could not be arrived at. The Chairman proved conclusively that as the weavers were paid on too high a scale, their weekly earnings being double those of the spinners, he advocated a reduction of 25 per cent. which could not fairly be objected to. The weavers being recruited from spinners and being attracted by a high scale of wages, there was a falling off in the number of spinners, whereas, if this great discrepancy in the earnings of these two sets of workers were reduced, there would be no difficulty in procuring a large number of spinners, and equilibrium would be preserved. This is as clear as day-light, but some of the members of the Association would not see it till that stern disciplinarian, self-interest, brought about a change in their views. Of course the men were not slow to take advantage of this disagreement among their employers, and the paths of the firms, who were foremost in initiating the movement, were beset with difficulties. The mill "hands" joined in a general strike, but they discovered their mistake before it was too late and had to submit to the new terms. There was a ray of hope in this for the concerns that were opposed to the movement, and they, too, adopted the plan, but without experiencing the inconveniene of having their employés going on strikes, which might have been averted altogether but for their determined obstinacy.

In regard to the general complaint that the supply is greater than the demand, there is only one way that presents itself of cutting the Gordian knot of the difficulty,—*viz.*, by opening new markets for the product of Indian jute mills. It is a subject which deserves the serious consideration of the Association, and could not be postponed indefinitely. We admit there are great obstacles in the way of getting a footing in distant countries, which at present consume a small portion of the manufacture, or where it is not known at all; but until such an outlet can be discovered the prospect of the jute industry in India cannot be expected to improve.

It is unfortunate that Government will not see its way to offer encouragement to British enterprise in this country. The arbitrary manner in which the License Act II. of 1880 has been worked to the prejudice of such undertakings tells its own tale and adds to the troubles of the Association. The Collector of Calcutta assessed some of the companies under class I., that is, at the highest fees leviable under the Act, although they have been worked at a dead loss for some time past. The Association brought the matter to the notice of the Collector and the application was summarily rejected; the Commissioner of the Presidency Division was appealed to, but with no better success. As a last resort, the Lieutenant-Governor was memorialized; he, too, could not hold out any hopes of relief, and there the matter rests for the present. The Committee, however, remark that "they by no means accept the justness of the decision which has been passed, and do not disguise from themselves that it appears, that the whole subject is one rather of the productiveness of the tax than of the strict and fair application of the terms of an oppressive law,—a law confessedly unfair, inasmuch as it provides for a contribution to the funds of the State levied from special classes of the population."

THE BOLAN RAILWAY.

We find that we have been misinformed in connection with a paragraph that appeared in our issue of the 16th April regarding the project for the substitution of the Abt system on ten miles of metre gauge track of the Bolan line being "pigeon-holed for the present." We learn that the plans and estimates were ready sometime since, but, it is believed, are delayed in the office of the Chief Engineer of the N.-W. Railway at Lahore. Seven miles of Abt rack and two Abt Locomotive engines were ordered out from the makers some two months since, and will probably arrive by the end of this year. This experimental section will be laid down above Mach as far as Hirok, the end of the broad gauge, and if found successful, the metre gauge will be altered, and probably the line surveyed by Mr. O'Callaghan last year from Sibi to Mach will be taken in hand and the whole of the temporary line in the lower Bolan eventually done away with.

We have seen the amusing account of the line in the *Pioneer* in which the great cost of the Bolan Railway is put down to the cost of the changing station at Hirok and the station at the top called Kotal. We are assured, however, that these two stations certainly did not add 4 per cent. to the total cost of the Railway, which was about 54 lakhs. The carriage of most of the permanent way material right across India from Calcutta, and which cost nearly nine lakhs, added heavily to the expense, as also did the bad epidemic of cholera and other diseases when the line was started. Whether at the time the Government were justified in going to the expense of the line is a matter of opinion, but the Bolan line enabled about 120 miles of the Sind-Pishin line on the plateau and down towards the Chuflur rift to be laid six months earlier than would otherwise have been possible, and also enabled 120 miles of permanent way material to be stocked on the plateau ready for the extension to Kandahar should necessity arise.

Notes and Comments.

The Chief Engineer, Bengal-Nagpore Railway.—Mr. T. R. Wyume, the Engineer-in-Chief of the Bengal-Nagpore Railway has arrived in Nagpore, and will probably be in Calcutta in about 6 weeks' time.

The Bengal P. W. D. Secretaryship—again.—Col. C. M. Browne, R.E. will in all probablity be gazetted Major General shortly, and in that case will have to retire from the service, unless he is promoted to the 1st grade of Chief Engineers. This, however, is unlikely, and the Bengal appointment may possibly be vacant again in July next.

Tardy Justice in the Consulting Engineer's Department.—We see that Mr. E. W. Arundell has at last been gazetted permanently as Deputy Consulting Engineer. The hard treatment endured by Mr. Arundell and Mr. Howard, in being passed over by Capt. B. Scott, R.E., was referred to in these columns, some time ago, and we are glad to see that the mistake has been rectified in part.

Calcutta Sanitation—at fault.—A Correspondent asks:—Can any one explain the reason of the frightful, soul-searching stink that pervaded the Park Street quarter of the town on Monday evening the 9th instant? It cannot be described by means of words, but if it be possible something should be done to prevent a recurrence. It may have been due to the heavy shower of that night stirring up the drains, or may have been blown over from the Salt Water Lakes; whatever the cause, it was simply purgatory to those who had to endure it.

Extension of Railway Communication.—The Kurrachee Chamber of Commerce and the Port Trust have decided to represent to Government the desirability of constructing two lines of railway, one from the town of Bhawulpore, on the Indus Valley Railway, along the left bank of the Sutlej, to a point on the Rewari-Ferozepore line, and the other from Hyderabad, through Omerkote and Southern Rajpootana, to the town of Pachpadra in the Jodhpur State. The latter line will bring the trade of Delhi and Agra by more than 100 miles shorter route to the sea and the general opinion is that it will pay handsomely.

Trans-Frontier Telegraph Extension.—The Burman Telegraph lines are already connected with those of Siam, and a connection might also be very easily effected between the Burmese lines and the Chinese, say between Bhamo and Talifu. For some reason not apparent to the public, the Indian Government cold-shoulders that proposal, perhaps also in deference to the advice of individuals who are much opposed to cheap telegraphy. Yet the telegraphic union between India and China would be a most useful measure for the general interests of both countries apart from the life it would infuse into their respective telegraph systems.

The B. I. S. N. Co.'s new Vessel.—We learn that Messrs. A. and J. Inglis, Pointhouse, Glasgow, have launched a steel paddle-wheel steamer, named the *Moulmein*, a vessel of 850 tons gross, and measuring 256ft. by 31ft. by 13ft. 9in. Built for the British India Steam Navigation Company, and intended for their passenger trade between Rangoon and Moulmein, she will have accommodation for about 2,000 passengers. She is being supplied by the builders with a set of three-crank triple-expansion engines of 2,100 horse power indicated, the first of the kind ever fitted on board any paddle-wheel steamer in this country. Steam will be supplied from two large double-ended steel boilers, the working pressure being 160lbs. per square inch.

The Director, N.-W. System.—The appointment of Colonel Conway Gordon, another R. E., of course, as Director-General of Railways, has led to his place being filled by Colonel Wallace, also R. E. But it may well be asked why a "Director" is needed for the N.-W. System more than for any other? The post was well enough as a place of refuge for Colonel Gordon, but it has no other justification. If it is necessary,—what share, has the Director-General in the administration of this system? The money would be better and more sensibly spent in strengthening the Director-General's office, which at present is on all hands admitted to be weak beyond contempt. The "Director, N.-W. System," must, of course, be always an R. E. officer. This may have something to do with its being continued. "Dowb" must be provided for.

Boilers in use in the Ranigunj Sub-Division.—The result of the enquiry recently instituted by the Sub-Divisional Officer in compliance with instructions received from the Local Government shews that there are at present in use in all 178 boilers in this sub-division, representing, approximately, in the aggregate 4,665 H.-P. and classified as under:—

Boilers:—	No.
Under 10 H.-P.	2
10 to 20 H.-P.	59
20 to 40 H.-P.	106
40 to 60 H.-P.	10
60 to 80 H.-P.	1
Total ...	178

We are indebted to the Sub-Divisional Officer for this information.

Southern Mahratta Railway.—A great injustice has been done by the appointment of Mr. Baggallay, Assistant to the Chief Engineer, Southern Mahratta Railway, to act for Colonel Lindsay, Chief Engineer, during the latter's absence on furlough. Mr. Baggallay is quite a junior officer, and supersedes Mr. W. Lind-Buyers, Superintending Engineer, Mysore extension, and other officers. Mr. Buyers is an experienced officer, with twenty-five years' service; he is superior in rank to Mr. Baggallay, and on a former occasion acted for Colonel Lindsay when the latter was on leave. One result of this bit of Dowb-ism will probably be the loss to the Southern Mahratta Railway Company of one of their best, most experienced, and hard-working Engineers, for we understand that Mr. Buyers, who is a Government Executive Engineer of the first grade,—his services having been lent to the S. M. R.,—has intimated to the Agent of the Company his wish that his services be replaced at the disposal of the Government.

Securite *vs.* Melenite.—This is, indeed, an age of explosives invention. No sooner have the French announced *melenite* as the most powerful explosive yet invented than it is followed by a still more powerful German rival called *securite*. The latter is credited with powers and properties which dwarf the former into insignificance. The new explosive, now rapidly replacing others in German

mines, is said to be the most powerful explosive agent yet placed before the public. It can be subjected to the severest treatment, unlike *melenite* and other explosives, with impunity. Under the percussive action of a sledge hammer, its behaviour is remarkable, giving out no explosion, and it can be manufactured, transported and otherwise handled with perfect safety. It is flameless, smokeless, and devoid of properties injurious to health. Unlike its French rival and other known explosives, it is unaffected by extreme changes of temperature—heat or cold—and it is considered most suitable for shells. It is declared to be the safest explosive known.

FRONTIER RAILWAYS.—Our Correspondent writes:—General Browne has started for Simla preparatory to proceeding on furlough, and Mr. O'Callaghan has taken over the S.-P. Railway. General Browne, starting from Quetta, accomplished the journey to Sibi *viâ* Bostan and Sharig in less than ten hours, though he was delayed over two hours on the road, which speaks very well for the state of the line. The whole of the line from Quetta to Sharig *viâ* Bostan and the Bostan-Gulistan section is shortly to be opened for goods traffic, and has been inspected by the new Superintendent of Works, Sind Section, and the District Traffic Superintendent. There is a considerable passenger and goods traffic over the Bolan to Quetta, and even the local goods traffic between Sibi and Sharig is much larger than was expected, consisting principally of goats' skins. One more district is to be added to the number on the N.-W. Railway, as it is found that some of them are too long to be under proper supervision.

GENERAL BROWNE, R. E., BEFORE THE PUBLIC SERVICE COMMISSION.—It is, to say the least, amusing to read General Browne, R.E.'s evidence before the Public Service Commission at Simla, on the 5th May. Naturally, the vexed question of Cooper's Hill man *versus* Roorkee man was dragged into the discussion, or rather into the evidence. We hope that the Members of the Department who are affiliated to the colleges in question, will not allow themselves to be estranged in any way by the manner in which the witnesses before the Committee have been examined. Their sole object, at the present juncture, should be to work together to obtain equal privileges for all the officers serving in the Department. But it is simply ludicrous to hear that the Roorkee man can "walk round" the Cooper's Hill man in feeding workmen, "or has much more fixed ideas of discipline," or does not "quarrel with the Military authorities in a cantonment, whereas a man from England is in chronic hot water with them." We should very much like to know how many Cooper's Hill and Roorkee men together it would take to equal one Brigadier General in extravagance, and what would become of them all if they spent two hundred and fifty lakhs over their original estimates on any given work?

THE BRIDGE OVER THE JHELUM AT CHACK NIZAM.—Another of the large bridges which mark this year's railway construction work will shortly be opened. The last girders of the bridge over the Jhelum at Chack Nizam were erected a few days ago, and a short time will see the work finished. This bridge, some 70 miles below the first Jhelum bridge, will connect the North-Western system with the Sind-Sagar Railway, and open communication between Lahore and Dera Ismail Khan and the Salt Mines at Khewrah and the coal mines at Dhundote close by. The bridge is seventeen spans of 150 feet, rather over half a mile, and is carried on well foundations 25 feet in diameter, and 82 feet below low water. The river-bed has many seams of clay in it, rendering the process of sinking the wells rather slow; and as the river is concentrated at that place, and is not split up into several channels, the erection of the iron work had to be almost all carried out on staging in the water. Latterly the girders were erected on boats; the depth of water and strong current rendering it impossible to drive in piles. The well-sinking began in September 1885, and the erection of the girders in December last year; so that the work has taken just over 18 months to complete, and we believe the cost has been several lakhs under the estimate.

MUNICIPAL EQUITY AND LIBERALITY.—The farce of "All in the wrong" has been played out to the bitter end, at the last meeting of the Water-Supply Committee of the Calcutta Municipal Corporation, in regard to the question of bonus to be paid to the Engineering Staff, on the successful laying down of the 48-inch main. As an instance of liberality in rewarding conscientious and loyal servants of the public, this will remain a standing monument of the appreciation of their services and as an encouragement to others to go and do likewise. While the entire responsibility rested with the chief, Mr. Kimber, and it was due solely to him that the Corporation has been saved two lakhs, his eminent services have been amply remunerated by the payment of Rs. 5,000, and the family of his subordinate, the late Mr. Fenwick, who merely carried out the orders of his superior, has been voted Rs. 10,000, thereby conclusively proving that a dead man has greater claims to one's consideration than a living one whose further services are at our disposal. As for the understrappers who have ungrudgingly worked hard upon a miserable pittance and have borne the heat and burden of the day in hopes of a reward,—why, they have been completely left out in the cold—a warning to others to expect the like treatment under similar circumstances.

THE NEW RULE *RE* P. W. D., C. E., PENSIONS.—We hear, on good authority, that the Pension regulations recently granted to the Civil Engineers of the Public Works Department are to be revised in one important respect. It will be remembered that after 25 years' service a Superintending Engineer, who has served continuously for 3 years as such, draws Rs. 1,000 per annum extra pension, and a Chief Engineer of the same standing a further sum of Rs. 1,000 a year. A new rule about to issue, lays down that these extra pensions are only to be given for *approved* service, and are not to be claimed as a right. This is to say, that, in future, a pension fairly due to a man for long service can be withheld by the stroke of a pen of a Chief Engineer or Lieutenant-Governor. We do not believe that such a case is likely to occur, but nevertheless it is a slight to the Civil Engineers of the Public Works Department that such a regulation should be even contemplated. No rule of the kind has ever been applied to any other of the services in India, and the pensions of an officer in the Covenanted Civil Service, or of a Military man in Civil Employ are as much their own property as their accounts with their bankers. These distinctions are invidious to a degree, but they will continue so long as they are not strenuously resisted.

Current News.

MADRAS is the only place in all India which includes amongst its local industries a cement work.

THE Soldiers' Industrial Exhibition, for the Bombay Army, will be opened at Poona on the 5th September next

SEVERAL wagons have been derailed and the line torn up between Damaun and Pardi on the Bombay and Baroda Railway.

THE Lieutenant-Governor of the Punjab will open the Bridge over the Jhelum at Chack Nizam on the morning of the 16th instant.

IT has been ruled that those Royal Engineer officers who have been brought under the new conditions are liable to be transferred from one part of India to another.

THE Chittagong-Assam and the Benares-Puri Railway surveys have been completed, and the Engineers' reports are likely to be shortly in the hands of the Government.

THE Sewlal Motilall Spinning Mill, Bombay, with a large quantity of baled manufactures, has been destroyed by fire. The loss is estimated at six lakhs. The property was not insured.

MR. W. F. O'DONAGHUE, Examiner of Railway Accounts, Southern Mahratta Railway, has been appointed to officiate in a similar capacity in Madras, in the room of Major Biscoe, now on furlough.

WE are very glad to hear that Mr. A. Walters, H. H. the Nizam's P. W. Department, has been promoted District Engineer of Hyderabad in succession to Mr. J. Buchanan, C.E., appointed to the Inam Commission.

AT the instance of Government, the Madras Railway Company have agreed to undertake the execution of all repairs to, and the examination of, steam boilers belonging to the Madras circle of the Ordnance Department.

THE 1st and 2nd Simla Imperial Circles of the Public Works Department will be abolished from the 31st of this month. The whole of the native *employés* have received intimation that their services will not be required after that date.

WE believe it has been practically decided to change the gauge of the Rajputana-Malwa Railway from the narrow to the broad, and that Colonel Bissett, the Agent of the united lines, is to visit England immediately to arrange for the conversion.

THE Chief Engineer of the Madras Railway has been called upon to furnish, at an early date, a plan and estimate for the extension of the Madras Railway from Sooramangalam to the town of Salem itself—a project which has, more than once, been urged upon by Government.

THE regulations and rules relating to the Ruby Mines district in Upper Burma are likely to be published very shortly. Under these the Government of India will reserve the power of resuming their monopoly in the precious stones, at the same time that full and adequate protection is given to local rights.

WORK continues to progress satisfactorily on the Toungoo-Mandalay Railway, though apparently there is some difficulty about obtaining labour on certain sections. The Engineer-in-Chief recently passed along the whole route examining the works in progress, and was able to report well of the state of affairs.

BRIGADIER-GENERAL BROWNE, R.E., who has seen the completion practically of the Sind-Pishin Railway, now reverts to the Military Works Branch on being granted furlough. Mr. O'Callaghan succeeds him in charge of that most important section of our frontier railway system, to which the finishing touch is now being given.

MR. WYNNE, Engineer-in-Chief of the Bengal-Nagpur Railway, has arrived in India with a strong staff of Engineers for the new line. Much, of course, cannot be done during the hot weather and rains, but the arrangements to be completed during the next few months will enable the work to be begun in earnest next cold weather.

A PROJECT is on foot to lay down a steam tramway of two feet six inches gauge, between the city of Shahjihanpur and Khotar, passing through Powalyan, for a distance of 31 miles, along the present high road. A company has been formed with a capital of Rs. 4,00,000, in four thousand shares of Rs. 100 each, to carry out the project.

THE Junagadh Railway is making very satisfactory progress. The whole of the embankments and earthwork from Jetalsar on the Bhownugur-Gondal line to the terminus at Verawal—a length of about 70 miles—will be completed before the rains, and it is hoped that trains will be running from the junction to Junagadh, a distance of 17 miles, by next February. Mr. Knox, the Engineer in charge, may be congratulated upon the rapidity with which the work has been pushed forward.

MESSRS. VENKOBA RAO AND GOPAULKISTNIAH, of Calicut, having formed a Company for the construction and working of an extension of the Mysore section of Railway to Mangalore *viâ* the Seradi ghat and Buntwal, and to Udipi from Buntwal *viâ* Mooda bridge and Karhal, have applied to the Madras Government for a grant of the required land in the South Canara district on the same terms as those under which the Madras Railway Company are granted land by the State, and as the Mysore Raj has agreed to give the land required in their territory.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

PROBLEMS IN PHYSICAL GEOGRAPHY

SIR,—In your issue of the 23rd ultimo it is noted that the lowness of the Irrawaddy above Mandalay is causing anxiety.

The lowness of the Indus at the present season is also causing considerable anxiety. There have been no winter rains, and at the present level is only slightly higher than the minimum of last winter.

Being in an out-of-the-way place, I cannot refer to Atlases and the latest information on those rivers. But from the recollections of the geography, I learnt in my school days, I should think that the meteorological conditions are the same on the upper reaches of the Indus and Irrawaddy.

Could the Meteorological Department enlighten us on this point and could it give any information as to the amount of snow as compared with previous years in the back ranges of the Himalayas?

Though our nights are cool, as a rule, for the time of year, our days are hot enough, and the more rapid melting of the snows should have affected the Indus by this time.

KORBISHI; *May* 1. E. A. S.

RAILWAY CONSTRUCTION IN INDIA.

SIR,—The History of the Construction of Railways in India up to the present time may be divided into three periods—the Guaranteed Company period, the State Railway period, and the Kimberley—Chimerical or Chaotic—period, which is the present one. Lord Hartington may indeed claim to share the glory of having, by his half-hearted policy, produced the chaos, but as his successor in office, undeterred by continued failure, has again dared to take the reins of the India Office, the above designation will do.

The Guaranteed period was distinguished by good solid work, but by a certain degree of extravagance, which was the inevitable result of the certainty of 5 per cent. interest on whatever amount might be spent combined with utter inexperience on the part of the Military Engineer Officers whom the Government appointed to check the Railway Engineers.

The State period was marred by too violent reaction, with the result that a break of gauge was introduced into the system of main lines of communication; and minor errors may be noted such as the use at first of rails of too light a section—which had soon to be replaced by heavier ones—the laying of railways within the limits of common roads, the attempt to do without fencing, and the cutting down of station accommodation to an undue extent. But the largest metre gauge State Railway, the Rajputana-Malwa, and its North-Western continuation, the Rewari-Ferozpore Railway, together 1,412 miles of line, have been leased to a broad-gauge company, the Bombay, Baroda and Central India, until 1890, and already rumours are abroad that the whole of the leased lines are to be reconstructed on the broad gauge,—thus justifying Sir James Fergusson's opinion, which he boldly expressed at the opening of the completed Rajputana Railway in January 1881, that the metre gauge was "a great mistake." Within a short time from that date the strain on the rolling stock of the narrow gauge line, owing to it having to carry the through traffic between two large and level broad gauge railways over a line with steep grade and sharp curves, became so great that it was rapidly being worn out. The State Railway Engineers, however, many of whom had acquired their most recent experience on Guaranteed lines, introduced many valuable economies in construction, among which the adoption of steeper gradients, and the use of old rails for the framework of buildings are conspicuous.

The Kimberley period ought to be, and probably is, distinguished by good Engineering, the outcome of the experience gained in both of its precursors, but the ultimate cost of some lines will be much greater than it ought to have been, owing to the uncertain and shifty nature of the policy, or want of policy, of the Secretary of State, in pursuance of which a railway is begun in a hurry, then abandoned, and after years of discussion ordered to be constructed on a different gauge from that originally adopted, and by perhaps quite a different agency. But the most remarkable feature of the Kimberley period has been—the "private enterprise" dodge. This, indeed, was first invented by Lord Hartington, who, in his "epoch-making" despatch, of the 6th January 1881, strongly urged on the Government of India that when any reasonable prospect of success presented itself "an endeavour shall be made to encourage the raising of capital through private agency on the exclusive security of the success of the undertaking." Any step in that direction would, his Lordship said, meet with his most cordial support and co-operation. What an "exclusive security" may be, in the abstract, we need not stop to enquire, but—"illusive security of the problematical, or doubtful success of the undertaking" is, a phrase that would better describe the bait which the deluded shareholders of the Central Bengal Railway Company were induced to swallow. This particular "private enterprise" has already broken down, and Government are now considering the question of how best to compensate the Company by making over to it some more paying enterprise. The Bengal and North-

Western Railway shows much better prospects, because it has not been undertaken so directly in competition with che aper water carriage, but even in this case the eminent capitalists who undertook to please Government could not float the shares until Government had yielded and given a limited guarantee. To do Lord Hartington justice, it must be said that the possibility of the failure of the private enterprise dodge was from the first within his contemplation, for in the despatch from which the above is quoted he added :—" In the event of its becoming apparent that the due execution of this policy is impracticable, it may become desirable to consider whether a modified system of guarantee might not advantageously be adopted. By a modified system, I mean one so restricted in respect to time and to the rate of interest guaranteed as to give the subscribers a real interest in the efficient and economical administration of the Railway."

Here occurs the thought that the more business-like way of proceeding, with a view of relieving the State from the burden of the perpetual five per cent. guarantee, and at the same time providing for the construction of railways in India by private enterprise, would have been to announce that a perpetual guarantee at so high rate would never again be given, and, if it did seem possible at once to fix the terms of a limited guarantee that should be applicable to all cases, to invite offers for each particular case. To say " I'll ne'er consent," and then to make the surrender of virtue, that has been necessary in the cases cited, is as humiliating as it is unbusiness-like.

H. W. C.

HOW NOT TO DO IT.

SIR,—Dalhousie, one of the prettiest and healthiest of our Sanitaria in Northern India, is the only one of our Hill Stations in the Panjab to which access by a Cart Road is, thanks to the Engineers of the Military Works Department, absolutely denied. The road—bridged and faultless in its gradients—exists, but, notwithstanding these facts, visitors and the summer residents who resort there year by year from April to November, have still, when they get out of the train at Pathankot, the present terminus of the A. and P. Railway, to endure the discomfort inseparable from a journey of 20 hours in a *doolie* from Pathankot to Dalhousie.

Some years ago when the A. and P. Railway project was first taken up, great things were prophesied for Dalhousie ; the 10 hours' *dák ghari* journey to the foot of the hills would be reduced to 4 hours by train ; the *doolie* road still in existence would be realigned or shortened ; and *tongas* were to take us up in about 8 hours. Men would be able to drink their *Maçon Johanisberger* or *Pilsener* at reasonable rates. Pianos or heavy furniture could be brought up to the Mall in carts instead of on *Kahars'* shoulders ; the ordinary requisites of life would be cheaper ; and existence would become a pleasure in a place where "naught save man is vile." Hope told a flattering tale and those unregenerate mortals (outside the magic circle of the Military Works) who saw themselves and families in beatific vision whirled up at racing speed over a beautiful level road where gradients were never to exceed 8 in 100 were speedily doomed to disappointment. True to the letter of its promise, a fine road was made by the Department of Military Works, and its maintenance, save the mark, entails a yearly expenditure on the State of a sum which *has five ciphers behind the first figure*. In vain has the Anglo-Indian public called attention to the matter. The Military Works Engineers will not allow the public to use the road. A Company was started for running *tongas* on the road, horses were hired or purchased, vehicles built, even the drivers belts and bugles had been ordered, when the Superintending Engineer, 4th Circle, Military Works, curtly informed the Company that permission would not be granted to run their vehicles on the road.

About four years ago, Sir C. Aitchison, Lieutenant-Governor of the Panjab, visited Dalhousie. The Municipal Committee in the ectacies of having been granted the inestimable boon of Local Self-Government, drew the attention of Sir Charles to the anomaly. Sir Charles, a hard-headed, practical man, promised a full enquiry into the matter. The collective wisdom feeling sure that the matter was in safe hands effusively thanked him, bowed and withdrew.

Sir C. Aitchison set the stone rolling, and all the moss it gathered after about six months' correspondence was a curt communication to the effect that "the Bridges on the Dalhousie-Lunsu Road were not strong enough for heavy cart traffic." This, of course, established two alternative theories, either the carts were exceptionally heavy, or the bridges exceptionally bad. Cynically disposed persons were led to accept without any reservation the latter hypothesis : however, there the matter stood, and a strong, well-intentioned Governor like Sir C. Aitchison, was foiled by the miraculous ingenuity of certain Engineers in the exercise of the faculty of *how not to do a thing*.

As the matter really stands, it would appear that the R. E., who aligned the road, did so without due regard to the natural formation through which a considerable length of it would pass—loose shale and shingle, which refuses to stand at any angle. The road has been well and substantially bridged, the gradients are admirable, while retaining walls, scupper and catchwater drains, and every accessory or means essential to the safety of a good hill road was allowed for, but the one fatal defect was the alignment through a defective and treacherous natural formation.

From Pathankot to Lunsu, about 27 miles from Dalhousie, the road is good, a few trivial improvements at a very small cost only are required ; from Lunsu the cart road takes off and the difficulties begin : the hill sides *slip* after every heavy fall of rain and bring down tons upon tons of detritus on the road, which in many places is carried bodily down the ravine, and the difficulties and expenses of maintenance are simply enormous. Engineers, who happen to have had experience in hill road construction, maintain that from Lunsu to Donera the trace should have followed the *doolie* road, gone below the Donera *dák bungalow*, crossed the Katlu torrent about half a mile below the present timber bridge, struck one of the outlying spurs of the Táràgarh hill, and then with a judicious alignment by a series of gentle gradients joined on to the *doolie* road at the Katassui *dák bungalow* (a mile from Bakloh where two regiments of Goorkhas are stationed), followed the *doolie* road which runs on a dead level as far as the Naini Khad, though avoiding the useless descent and ascent in and out of this ravine by crossing the torrent higher up. From this point with a gradient not exceeding 1 in 50 in any one place, a good alignment could have been run, bringing the cart road up to the church, which is about the centre of the station. Such a scheme is not only feasible, but could be completed at a cost not exceeding the expenditure wasted on three years' maintenance of the Lunsu-Dalhousie Road. To perpetuate the present state of affairs is little short of a scandal on the administration. Perhaps Sir T. Hope, or even the Viceroy himself, might take measures to remove what is a standing reproach to the Profession and a mockery of the Public.

S. P. Q. R.

Literary Notices.

TRANSACTIONS OF THE INSTITUTION OF ENGINEERS AND SHIP-BUILDERS IN SCOTLAND.

WE have the numbers for December 1886 and January and February 1887 before us, and note that the first contains the conclusion of the discussion of Mr. Robert S. Moore's Paper on "The Construction and Laying of a Malleable Iron Water Main for the Spring Valley Water Works, San Francisco." The last number contains a Paper by Mr. Robert Dyer on "The Education of Engineers," which we hope to notice *in extenso* in an early issue.

TREATISE ON ELEMENTARY TRIGONOMETRY. *By John Casey, LL.D., F.R.S.* Dublin ; Hodges, Figgis, and Co. 1886.

THIS little book is what would be expected from such an experienced teacher and accomplished mathametician as Dr. Casey. The text is distinguished by that clearness and neatness of demonstration which is so characteristic of this author's other works. The arrangement of the matter is unique and admirable and the examples and exercises select and well chosen. The present work contains all the propositions of Plane Trigonometry that do not require Dr. Moivre's Theorem ; and will be followed by an advanced treatise containing all the higher parts of the subject, including Hyperbolic Functions and Spherical Trigonometry.

FORESTS REPORT, Madras Presidency—1885-86.

THE Forest Department of the Southern Presidency is divided into Circles, Southern and Northern, under independent Conservators, which arrangement we are disposed to consider a disadvantage on administrative grounds.

We glean from the volume before us that the cost of the establishment and of the work that it did was Rs. 9,36,421, the revenue that it brought in was Rs. 11,98,600, and the net profit to Government was, therefore, Rs. 2,62,179 or 22 per cent. of the gross receipts.

The sources of income are various, but the chief items of yield from working are derived from 3,513 tons of timber, 21,990 tons of fuel, 86,287 bamboos and 379 tons of minor produce disposed of, realising Rs. 2,01,994 in the Southern Circle and Rs. 1,60,851 in the Northern Circle. In connection with these operations, it is interesting to learn that in the Southern Circle, 1½ miles of tramway line were laid in South Arcot, while in the Nellore district of the Northern Circle, 2¼ miles were opened and utilized for the conveyance of casuarina fuel. The result has, apparently, been so far very satisfactory.

When it is considered how much of the profit of forest work can only be looked for in the future, and how much of its benefits are not to be appreciated in money at all, these results must be held satisfactory.

General Articles.

HYDRAULICS.

By Captain H. D. Lane, R.E., Principal, Engineering College, Madras.

A Review.

This really excellent manual should be welcomed by all Hydraulic Engineers, as it gives, in a most convenient shape, all formulæ required in practice, and in a clear, lucid manner the author discusses them and points out in each case which of the numerous co-efficients given by different authorities and obtained under varying conditions is the most suitable to the particular case in hand. Any student of intelligence taken through this manual by a competent teacher, or even carefully studying it alone, would, in a comparatively short time, learn all that he need know of the theory of Hydraulics, in order to become an efficient designer of canals, irrigation tanks, and water-works, while the numerous examples given for working will be found a great aid to the right comprehension and thorough grasping of the subject.

The manual is divided into eight chapters as follow :—Hydrostatics, discharge from small orifices, discharge from large orifices and notches, practical cases of discharge from orifices and notches, discharge under variable head, flow of water in pipes, flow of water in channels, and flow of water in rivers. It is thus seen that all branches of the subject have been considered, and in every case the work is well up to date.

In the third chapter Bernoulli's theorem is stated and this difficult subject is very finely elucidated, and the next chapter, by examples, shews the practical application of the formulæ arrived at in chapter 3 by more abstract reasoning.

The consideration of the discharges of the many different forms of weir is particularly useful to the Canal Engineer, who now, for the first time, finds together in one work all that has been learned by experience concerning the co-efficients to be used, which so much vary with circumstances. It is a pity that this portion, and indeed the whole work, should be disfigured by the use of the words 'kalingula,' 'anicut,' and 'bund,' which are incomprehensible to readers in Europe, and there is really no excuse for using them, as they have in English exact equivalents, unlike 'cutcha' and 'pucka,' which are such convenient words that it is difficult to refrain from writing them.

The chapter on flow of water in pipes is particularly good and the author has, very properly, in working examples used the co-efficients for old and slightly encrusted pipes. In India, where many small schemes are now always got up for water-supply to small municipalities, this portion of the work under review will be of the utmost use to Engineers who may have to prepare them without previous experience in water-works.

A casual glance at some of the examples gives the idea that they were set as questions originally by persons having little practical experience; for instance, example 10, page 81, gives the condition of a channel which would be about 400 feet wide and 4 feet deep with a velocity considerably exceeding 4 feet per second. It is needless to say that such a channel could not be maintained in any ordinary soil. Again, example 2, page 3, is rather startling; the deviser of it is evidently under the impression that the hinges, as he calls the pintle and collar strap, take the pressure of the water against a lock gate in place of it being borne by the reaction of the hollow quoins. He takes the width (or as he calls it the length) of the gates at 5 feet, or exactly half the width of the lock, so he evidently does not mean to have any mitre to the gates, so what supports them in the middle when they meet is not clear.

The plates illustrate the text most admirably and would be easily referred to if only the number of the figure in each sheet were printed on the back, so that the one required could be found without opening a number to see what was inside.

With the exception of the trifling blunders pointed out as above the manual is all that could be desired, and should be owned by every Engineer in India, whatever branch of Civil Engineering he may be engaged upon.

J. H. Apjohn.

SEWERAGE SCHEME FOR KARACHI CITY AND ITS SUBURBS.

By J. Strachan, M. Inst. C. E., Municipal Engineer.

(Continued from page 269.)

II.

The sludge would have to be removed at a cost which would certainly exceed the cost of pumping the whole sewage of the town on to land suitable for a sewage farm. From the most satisfactory experiment made in England it has been found that the cost of producing a manure in large quantities from sewage, by chemical treatment, amounted to £1-0-0 per ton, while its market value was about 12 shillings. Thus in Karachi, the sewage treated chemically would produce about 5,700 tons of manure per annum at a cost of Rs. 57,000. The value of the manure would be about Rs. 34,200 per annum leaving a loss of Rs. 12,800 per annum, besides the cost of removing the sludge which would amount to at least Rs. 15,000 per annum.

8. The Pneumatic systems as carried out by Liernur and Shone have few advocates in England, and I merely refer to them here, not because they are systems I would think of recommending for adoption in Karachi, but because some of the Members of the Corporation may have heard of them without at the same time having heard the opinion of practical men in England regarding them. For this purpose the following description of the Liernur system as given in the transactions of the Institution of Civil Engineers may be interesting and useful. In a building in any convenient part of the town is placed a Steam Engine which drives an air pump so as to maintain about three-fourths vacuum in certain hermetically closed reservoirs sunk below the floor. From these reservoirs central pipes radiate in all directions following the main streets. On these central pipes are laid, from distance to distance, street reservoirs sunk below the pavement. From the street reservoirs up and down the street, are laid main pipes communicating by short branch pipes with the closets of each house. All the junctions of pipes with reservoirs are furnished with locks so that they can be shut off or turned on at pleasure like water mains and are got at by cock boxes and turned by keys in the ordinary way. The vacuum created in the central building reservoirs can be communicated to any given street reservoir so as to furnish the motive power by which, when the connections with the houses are opened, all the closets are simultaneously emptied. The contents of the street reservoirs are in like manner drawn to the central reservoir whence they are transferred to hermetically sealed tanks above the floor and then filled into barrels for transport into the country. The objections to this system are manifest. First, it only deals with solid and a limited quantity of fluid matter; secondly, the machinery is enormously expensive; thirdly, it is liable to get out of order; fourthly, the closet arrangements are offensive and it is objectionable that the public should be at the mercy of the man entrusted with the duty of opening the connections; fifthly, the decanting into barrels is offensive. These objections are, I think, sufficient to show its unsuitability for supplying the wants of Karachi. The town council of Southport in England contemplated adopting the Liernur system, but before finally deciding to do so, appointed a Committee to visit Leyden, where it was in operation and to report upon it. Their report dated 15th December 1874 contained the opinion of the Committee, that the system was unsuitable for similar reasons to those already given, they farther remarked that in a town of so large an area as Southport relatively to population the pneumatic sewerage works would be enormously costly to put down and maintain; an argument which applies with special force to Karachi.

With reference to Shone's system it may be briefly described as being in every way similar to Liernur's with this exception that the sewage is forced through the pipes by compressed air instead of being drawn through by suction. All the reasons brought against Liernur's system are applicable to the same decree against Shone's system.

9. The tidal outfall system has much to recommend it, especially to the inhabitants of a sea-board town and is the system which at the first glance would appear to be most suitable for this city. But unfortunately the only convenient place for the discharge of the outfall sewer is in the harbour immediately to windward of the town. This I fear would in itself be a fatal objection even if the opposition of the Harbour Board to sewage being discharged into the harbour, could be overcome. As the primary considerations in regard to the disposal of the sewage are the health and convenience of the community at large, and as some eminent chemists declare that zymotic diseases are propagated by germs of organisms contained in sewage which are practically indestructible in water, I cannot conceive that it would be conducive to either to have a continuous flow of sewage at the point indicated.

10. There remains now for consideration the fourth system, namely, the application of sewage to land. In the transactions of the Institution of Civil Engineers, it is stated that in 1880, the Municipality of Paris expressed the opinion that in that city cesspools should be abolished, that all fœcal matter should be discharged into the sewers and that the sewage waters should be subsequently purified by irrigation. The Drainage Commission of France decided in 1882, that the sewage waters of Paris, in the state they were in then, containing at least a fifth of excrementitious matters, could be safely used for irrigation; basing their decision on the results of sewage farms abroad and the experience at "Genne Villiers," (where a small sewage farm had been for some time worked) of the purifying influences which result from aëration and dilution. Therefore the Municipal Commissioners decreed that each lodging should be provided with a water-closet, siphon trap and ventilating pipe rising above the roof and supplied with not less than 2¼ gallons of water per head per day. They determined that cesspools should be abolished as soon as practicable and condemned equally the tub and pail system, and all other methods of receiving sewage which are exposed to leakage, or which necessitate its remaining for a time in the dwelling and its subsequent removal and treatment. Finally they urged that the systems of irrigation should be extended both for dealing with Paris sewage and also for the sewage of towns in the neighbourhood as the purification of sewage water by land irrigation can be effected without any injury to the public health. Such is the powerful testimony from France. In England this system has many adherents. It is only fair to add that it has also been condemned by some Engineers in England. Fortunately the grounds of their objection to such schemes in England will not apply to India. Their chief objections are: 1st the difficulty of procuring a sufficient area of suitable land for a sewage farm, as all land in the immediate neighbourhood of a large town is very costly, 2nd the difficulty of disposing of such a large quantity of sewage, and 3rd the difficulty in carrying on the sewage farm without incurring a heavy annual loss. In Karachi the first and second difficulties are easily surmounted, for on the north of the Lyari river there is a sufficient area of land under the control of the Municipality, admirably situated, and suitable for a sewage farm. The proportion of acreage of the farm to population is a question which has been much discussed and on which no reliable conclusions have yet been drawn, in fact it would be folly for any one to attempt to set up a fixed standard as the proportion is clearly governed by so many varying circumstances such as the character and depth of the soil; the amount of rainfall, and depth of natural drainage, &c. The population of the whole area to be sewered may be taken to be about 80,000 and the amount of sewage to be disposed of, will not in my opinion be more than 20 gallons per head per diem. It is customary for Engineers in England to allow for 25 gallons per head per diem, but this allowance always includes a certain proportion of the rainfall, which flows from back yards, sunken areas and the like, for which no provision need be made in Karachi. Twenty gallons per head may therefore be safely taken as the basis of calculation. As the soil at the site I would select for the sewage farm is porous and the subsoil water is far from the surface, I am inclined to think that a proportion of 400 to the acre will not be too high. Colonel Ducat, R.E., in his report on the sewerage of Sukkur, fixes the proportion at that place for a small sewage farm he recommends there at 300 per acre, but the land selected may not be so favorably situated with respect to the conditions just named as that at Karachi. A proportion of 400 to the acre will require a total area of 200 acres. But, as I would suggest that alternate halves of the farm should lie fallow every year in order to prevent it becoming over saturated or offensive, an area of 400 acres will be required in all. Should it be found, however, from experience that a population of 400 to the acre is too much, it will be any easy matter to take in more land for the farm as there is plenty to be had in the neighbourhood.

(To be continued.)

SCRAP RAILS IN CALCUTTA.

FOLLOWING the example set by the Engineers of the East Indian and Eastern Bengal Railway, notably by Sir Bradford Leslie, in the case of the scrap wrought-iron rails, too much worn for use in the running roads, native builders in Calcutta have rushed in to follow. So long as they confine themselves to using these rails as floor and roof beams, they cannot go far wrong, but the danger—and there is a considerable one—is when they attempt to use trusses of considerable span made up of these scrap rails, or when they are made up into standards or columns to carry heavy weights. They, and better men, often overlook the fact, that whilst often using an excess of strength in material necessary to carry the load required, that the connections are all important. Often the whole strength or capability of a truss is dependent on the diameter of a bolt or the goodness of a rivet, metal and workmanship, or in a column dependent on the strength of a castiron lug or plate.

The Municipality, if they have not, should be vested with power through their Engineer to examine and sanction or condemn all such structures, and all *details* of such work should be subject by law to his close scrutiny or that of a responsible and capable officer duly authorized—a sort of District Surveyor.

One of the latest forms of use of scrap rails may be seen in the over-bridges lately built over the Chitpore yard lines of the Eastern Bengal Railway.

The rails of the openings over the running lines are curved to the segment of a circle and placed in close contact side by side and filled in above with concrete, every eighth or tenth rail being trussed. It hardly commends itself as an economical treatment, and must be more costly than a brick arch, taking the cost value of the rails used at 6 annas a lineal foot. Brick arches could easily have been built on the rail standards used in place of brick piers between the lines. It is certainly not a saving in weight of material, and it is questionable if there is any saving gained in reduction of height of roadway. The rail over-bridge of the goods yard of the East Indian Railway at Howrah is a far better example of an overbridge built of rails. The former savours of a use of rails for the purpose of using rails, not as true economical engineering.

Another point requiring supervision and care in the use of rails as columns or standards is in the treatment of the bases. The end of a rail only gives an area of seven superficial inches, and if the base plate is not sufficiently thick and of sufficient area, a rail end with a good load on it will prove an excellent punch, to the utter failure of the foundation.

It is therefore evident that considerable care and caution is requisite in the proper and safe use of scrap rails in buildings, especially in the connections. B.

REPORT ON THE PREVENTION OF THE WASTE OF WATER.

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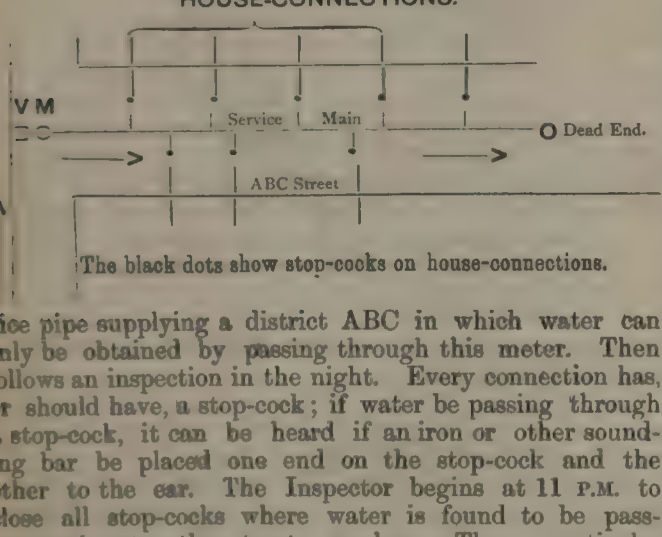
I.

(Continued from page 274.)

9. 180 Meters known as "Deacon's Differentiating Meters" were fixed during 1885-86. Water passing through these meters is caused to move a pencil which is just in contact with a diagram fixed around a drum which revolves once in 24 hours. The effect of dividing this diagram into periods of one hour each and also of dividing it into spaces representing supplies at the rate of 100 to 5.000, 6,000 or even 10,000 gallons per hour is, that the supply in 24 hours, which in an ordinary meter appears as a lump sum on reading the dial is split up or "differentiated" into its component hour, or shorter period quantities, and at a glance can be determined not only the gross quantity passed, but when, and how, it passed. When these meters are first affixed to any service mains under constant supply and diagrams taken, they always reveal the fact that a large quantity of water flows away, at a more or less steady rate, between the hours of 11 P.M. and 4 A.M., *i.e.*, at a time when, generally speaking, people are at rest, and business and domestic works are suspended. To this quantity the term "invisible" waste is applied, because generally it occurs underground or in such situations as are not observed without special and careful inspection. There is no redeeming word to be said on account of this class of waste, and it is generally far larger than the waste from all other causes put together, and it can only be detected by special examinations.

10. For this purpose a meter M. is placed on the ser-

HOUSE-CONNECTIONS.



The black dots show stop-cocks on house-connections.

vice pipe supplying a district ABC in which water can only be obtained by passing through this meter. Then follows an inspection in the night. Every connection has, or should have, a stop-cock; if water be passing through a stop-cock, it can be heard if an iron or other sounding bar be placed one end on the stop-cock and the other to the ear. The Inspector begins at 11 P.M. to close all stop-cocks where water is found to be passing and notes the street numbers. These particular connections and the fittings are afterwards examined during the day. When the whole district has been travelled through in the night and all the stop-cocks closed where noise is heard, the diagram on the meter indicates the quantity of waste which has been shut off. The remainder is due to the mains, to the ferrules and service pipe in front of the stop-cock and to the stop-cock itself. If this remainder be large, indications of it are usually met with during the night-inspections and can afterwards be traced. In this way the waste is localized, and its detection rendered easier and more certain, and there is a register of results on the diagrams taken from the meter. *Fig* 1 of the annexed plate illustrates the result in one such district. A great advantage of this system of inspection is, that only those premises need be examined where noises were heard; the time of the Inspector is not taken up, as in the case of house to house inspection, by examining premises where the pipes and fittings may, *or may not*, be faulty; and occupiers are not troubled by unnecessary visits to, and inspections of, their premises.

11. When I entered on the duties of my office, I found that this systematic and only effectual and proper way of working the meters had not been attempted: and the opinion was generally prevalent that, as it involved constant supply, it could not be undertaken until the supply from the Tansa Lake just commenced was received. Such a procedure would be very imprudent. The five, probably six, years which must elapse before this supply will be available, will be most anxious and difficult ones to pass through, and all the water wasted will increase that anxiety. But this is not all: the city is unprepared for a constant supply. The waste is extremely large, and to place the whole city on constant supply at once and without preparation would lead to great disappointment in the result, because the new supply would scarcely be more than equal to the waste. In seven of the districts in which the consumption of the seven hours' intermittent supply and constant supply before inspections can be compared we find the intermittent consumption to be less than half that of the constant, or as 100 is to 210. A similar comparison of nine districts in the north gives a consumption of 100 to 195 or 142,776 gallons per day intermittent and 278,509 constant. It seems to me, therefore, that the present and next few years should be years of the greatest possible activity in endeavouring to put the mains, service-mains and fittings into a state worthy to receive constant supply. It is too early yet to say what part of the city can be placed on constant supply before the new supply is received; much depends upon the powers, staff, and facilities afforded; and much on the rainfall supplying the present lakes and also the rainfall in the city itself. Granted favorable events to these factors, it seems to me to be practicable to place a large part of the Municipality on constant supply and the remainder on 16 hours per day.

I prepared immediately I came to commence operations, and found that both yourself and the Municipal Commissioner desired the district of Nagpada and Kamathipura to be first tried. From 20th of May, when I arrived, to the 20th of June, the Bhandarwada Reservoir was so low and the complaints of insufficient supply were so numerous that you advised me to await the rains before commencing. This was prudent, because a very large increase in the consumption is caused by constant supply, until the wastage can be detected and reduced. On the 23rd of June the first diagrams of intermittent supply were taken in Nagpada and Kamathipura, and on the 3rd of July constant supply was given, and has been continued since, with a few interruptions whilst effecting repairs. It soon became evident that the leakage was so great, and the elasticity of the Bhandarwada division was so small, that this district was as much of it as could be attempted for the present. The northern portion of the Island was next taken and diagrams affixed, first to seven of the most northern districts supplying Mahim, Sion, Dharavi, Matunga, Wadala and Naigam on the 23rd of July, and extended a few days later to Parel. These (except Mahim) were placed on constant supply on 4th August. The Tulsi district will be commenced as soon as the strength can be spared; first as far as Chowpati, then to Thakurdwar Road and afterwards to Money School. Diagrams of the present intermittent supply are now being taken in the first two districts of this division.

By taking one portion at a time in each division and putting each right before going to another, the whole city may be examined.

12. We now come to the facts revealed by the diagrams as reduced in the book of tabulations forwarded herewith,* first in Kamathipura and Nagpada. Under intermittent supply it is seen that in Shaik Bodeen Street 11,700 gallons were supplied on the average in seven hours or nearly 1,700 per hour.

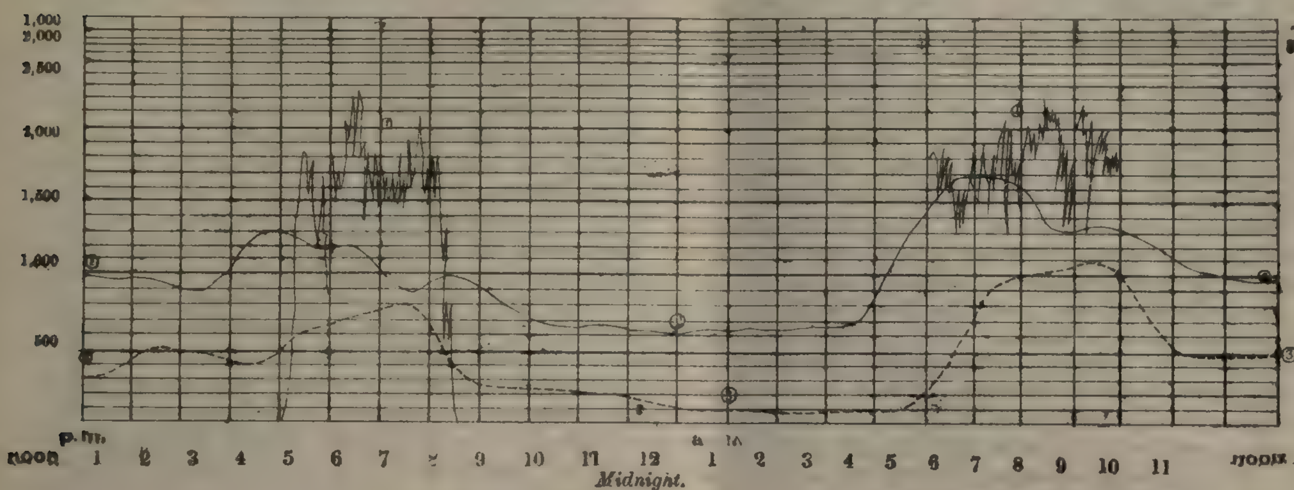
	Gallons.
On the first day of constant supply were taken ...	29,800
On the second	22,200
And the average of 8 days after the first ...	22,800

* Not printed.

Fig. 1.

COMPARATIVE DIAGRAMS ½ FULL SIZE FROM SHAIK BODEEN 3" METER SHEWING

1. Intermittent supply		7 hours.	12,480	Gallons	Date 26th June 1886.
2. Constant	,,	Before inspections.	25,190	,,	,, 12th July ,,
3. ,,	,,	After ,,	11,380	,,	,, 31st Aug. ,,



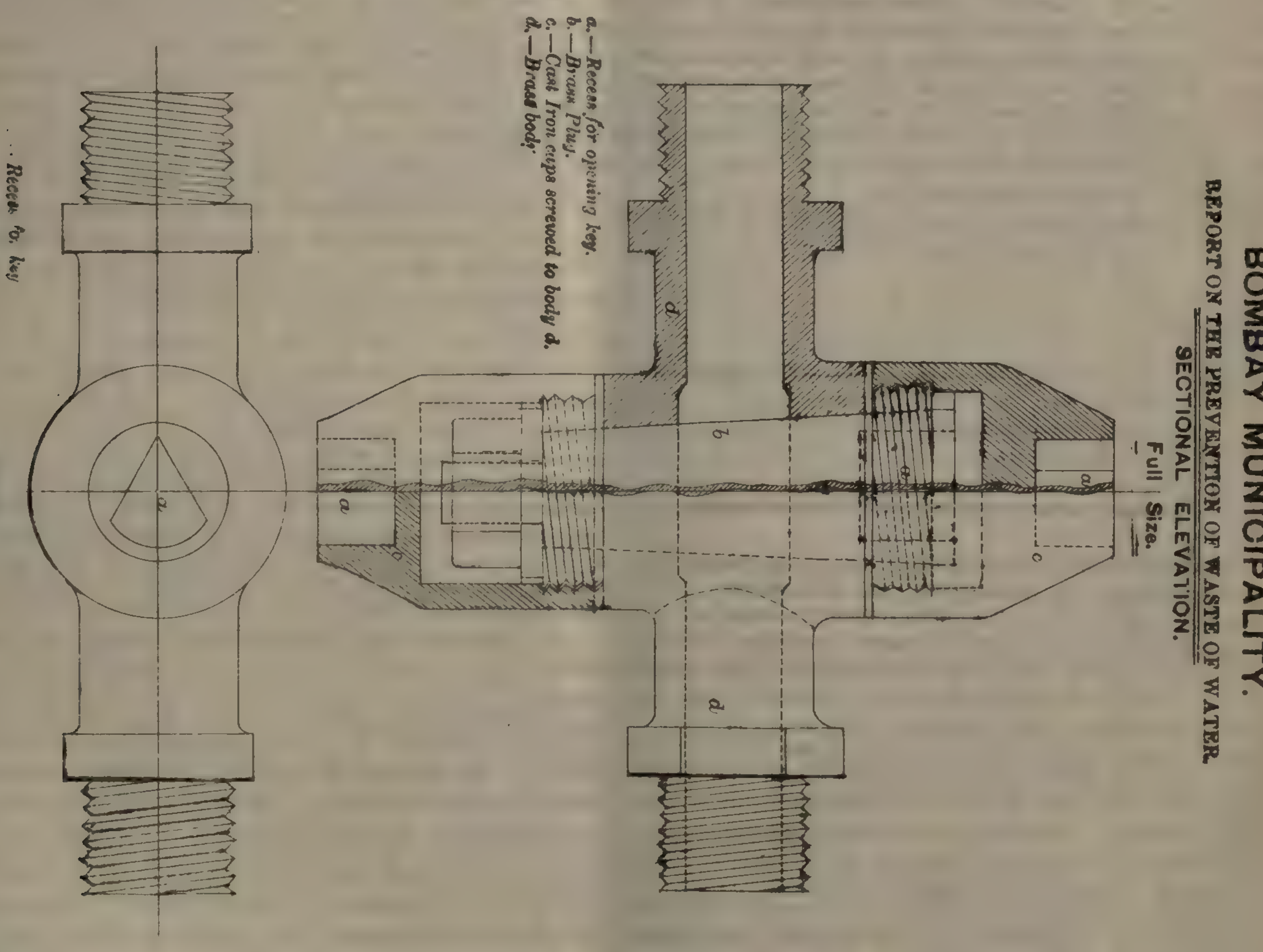


Fig. 3.

GRADUATED INDICATING PLATE FOR 3" METER.

HALF SIZE.

The first night-inspection was on the 13th and 14th July—

		Gallons.
For 7 days after this the supply averaged per day		18,723
For the next 7 days	... ...	16,565
For the next 7 days	... ...	17,094
Do. do.	... ...	16,354
Do. do.	... ...	14,225
Do. do.	... ...	11,595
Do. do.	... ...	11,832

Before the night-inspections the diagrams indicated during the night hours a steady flow at the rate of from 9,000 to 18,000 gallons in twenty-four hours or a wastage of 60 per cent. The wastage in the period six to thirteen days after the first night-inspection was from 4,000 to 10,000, averaging 6,000: a wastage of 36 per cent. The practical problem is, however, this:—" As all the water hitherto received has been consumed in 7 hours; can so much be saved of the waste in those seven hours of intermittent supply as will suffice to afford a supply for seventeen hours and the reduced waste during those hours, because some waste there always will be ?" So far as this street is concerned the answer is a weak—Yes. 11,700 gallons were used under intermittent supply, and latterly 11,800 gallons for constant supply. The average rate of supply is reduced from nearly 1,700 gallons per hour to under 425, with a maximum of about 1,500 for two hours in the morning. The pressure must therefore be generally much better. As another example we might take—

Tank Street.—Under intermittent supply 22,200 gallons per day were supplied, the hourly rate being 3,200 gallons nearly. The first day of constant supply was 47,720 gallons; 17 diagrams between the 5th July and the 23rd July, the date of the first night-inspection give an average total consumption of 41,300 gallons, and a waste of 18,200 gallons per day. After night-inspections, the consumption in seven days' periods were :—

		Gallons.
From July 23rd to 30th ...	... ...	33,948
" 30th to 6th August	... ...	31,289
" 6th to 13th "	... ...	36,190
" 13th to 20th "	... ...	41,125
" 20th to 27th "	... ...	32,090
" 27th to 1st September	... ...	34,250

Take again Kharsedji Sukhlaji Street, 6″ main :—

		Gallons.
The consumption under intermittent supply was		92,900
1st day constant supply ...	... ...	212,350
2nd " "	... ...	196,550

(I put the second day to compare with first, because in all districts it is much less, which shows that the consumers have some regard for the prevention of waste.)

		Gallons.
Average July 3rd to August 3rd	... ...	194,682
After night-inspections—		
3rd August to 10th August	... ...	177,400
10th " to 17th "	... ...	116,550
17th " to 24th "	...Meter out of order.	
25th " to 1st September	... ...	73,712

And a considerable portion of this can still be recovered. Even at present, constant supply is being given with 20,000 gallons per day less water than was required previously to afford seven hours.

13. From these districts, fair examples of the whole, it is evident that there was a very large waste and that even in a short time an impression has been made upon it. The results obtained are to be regarded by no means as final, because sufficient time has not elapsed to have all the repairs needed executed and the districts re-examined. In commencing the night-inspections it at once became evident that stop-cocks were taking a very large share of leakage. From 1st July to 25th August the total defects discovered are thus classified :—

Stop-cocks	... ...	209
Service pipes	... ...	79
Taps	... ...	57
		345

Stop-cocks 60 per cent.

In the preceding eighteen months 700 notices had been served for repairs to stop-cocks. The stop-cocks in use are screw down and the leather washers frequently want attention. They are placed in all sorts of positions in the streets, which are all macadamized. The result is, that the iron boxes placed over them are frequently displaced, and, generally, either above or below the level of the road accordingly as it is wanting repairs or has been recently repaired. After every bed of new stone has been laid many boxes are to lift or would be lost altogether, and innumerable are the breakages made in the road on account of the stop-cock boxes, which number probably 14,000, the number of connections in 1885 being 14,448. They are therefore a source of injury to the roads, causing ruts and hollow places to form much more rapidly than would be the case if the road surface were undisturbed by them. The present system is thus very objectionable from the road-maker's point of view. Again, the boxes are frequently found with lids broken, displaced or removed altogether. These open boxes are dangerous for horses and other animals and frequently cause accidents.

The tap even when placed here is inconvenient for access and repairs, and there is the expense of building a masonry chamber and of providing the iron box and lid.

When the night-inspections are wanted, it takes the staff several days to find and place in proper positions the boxes in any district, and even when this has been done and the night-inspection follows, it requires one cooly to find the boxes, one to open them, one to clean them out and to find the tap and hold the sounding bar on it. In other words, four men are required to do what ought to be done by one man, and which is done by one man in England, and even then the speed is only a quarter of what it ought to be. I was present at the inspection of Tank Street. There were six persons engaged and an hour and a quarter were required to travel the street; it would have occupied, under a good system, a Sub-Inspector and his cooly half an hour. Some boxes were found displaced and almost every one full of mud and stones. This is the ordinary experience. Taking into consideration all these defects, it seems to me imperative that the system should be radically changed. Generally speaking, as soon as the service pipe reaches the side of the road it turns up out of the ground, for a few feet until it either enters a building or a passage. Taking advantage of this arrangement, practicable only, of course, where there is no frost, it seemed to me there were few disadvantages in placing the stop-cock in this situation. But a stop-cock of any pattern at present in use would be much tampered with in such a situation by mischievous and ignorant persons.

14. I therefore designed a tap as shown on annexed drawing *fig.* 2 and submitted it to you, together with a verbal statement of the observations above stated against the present system. What is required is a tap easily accessible to those who have a right to access, simple in construction and cheap, and which cannot easily be tampered with. The proposed tap has 5 parts only; the body, the plug, the two caps and the nut and washer fastening the plug in the body. The caps being screwed to the body will prevent any great leakage even if the plug be not tight, and being above ground any leakage will be at once visible. As there are no projections, I do not anticipate the cap will be easily unscrewed by mischievous persons or the tap tampered with. It will be plainly visible; no box will be required; the obstruction will be removed from the roads; and the present delay and expense to the work under report will be entirely obviated. Each tap will bear a number which will serve to identify it amongst the Inspectors, an identity which is not easy at present in many cases, where several taps are in the roadway and no house numbers opposite. The small key required for opening will also be the Inspector's sounding bar, if he needs one, and on his inspection he will have nothing to remove or to do but place his ear to the stop-cock. If water be passing, he will unscrew the top-cap, shut the plug and replace the cap. The advantages are many.

The disadvantages urged are, that they will be stolen if of brass; easily tampered with; and that they will not command the service pipe between the main and themselves. To the first objection, I should propose that, if found to be frequently stolen, the body and caps should be of iron; to the second, some other means of fastening could be devised if this fail; and to the third, that any leakage so occurring would be heard at the stop-cock when it is closed, and could be dealt with accordingly.

The number of stop-cocks is not exactly known, but it must be nearly 14,000. The cost of replacing will be considerable, but three things about the present system are perfectly clear and beyond argument:—1*st*, that it causes great loss of water; 2*nd*, that it is extremely expensive and objectionable in every way; and 3*rd*, that the detection of waste can never be successfully and economically made until it is radically altered. With tested fittings to be referred to later, there is no reason why the leakage should not eventually be confined within narrow limits, because the internal fittings are, compared with any English city, of an extremely simple kind and not numerous in comparison with the number of persons supplied; a given length of main too supplies in general a much larger number of persons than in Europe, and the service pipes are very frequently in a passage or outside a building where their course can be quickly traced and any leakage is visible.

(To be continued.)

MUD ARCHITECTURE IN PERSIA.

WHETHER the Persian Architecture were contemporaneous or derived from the Assyrian, Egyptian, or Indian, is a question into the investigation of which I am at present not prepared to enter, but certain it is, judging from the voluminous writings of competent men, that the Assyrian and the Egyptian were the most ancient styles which formed the groundwork of all others that adorn the various parts of the globe. Until recently it was supposed that the Persian architecture owed its origin to the Indian, but the study of the archœological remains of the various eastern countries has enabled the specialists engagedin the work to fix the date of the former structures far anterior to that of the latter or Indian. The birth of the Roman and Grecian styles, their semblance and peculiarities, are no longer invested with doubts or involved in mystery, which had so long exercised the minds of the enthusiastic students and travellers of the old and the new worlds. The arch-semicircular, Gothic with their many variations—the pillar, the capital, the dado, the architrave and the various details of ornamental construction—are no longer ascribed to accidental observations or similitude, but have descended to us from remote antiquity as the triumphs—though rude—of the Assyrian and Egyptian structural art. The evolutionary process which the art has, during its progressive descent to us, passed through has given to the world architectural beauties unapproached in the annals of Ancient Architecture.

If architecture is correctly defined as being nothing more or less than the art of ornamental construction, then I am bound to say that of all oriental nations the Persians appear the most advanced in the art wherein mud or earth plays a most important part. Any one journeying through or sojourning for a short period in Persia cannot avoid being struck with the high excellence which *mud, common mud*, can be made to attain in its employment in architectural works. Forts and fortresses, courts and country houses, palaces and public offices, colleges and convents, mosques and minarets, towers and temples, caravanserais and crown buildings, bazars and breakwaters, are all made of *mud—despicable mud* whose qualities in the constructive art, are only appreciated and acknowledged when moulded into bricks and burnt in a kiln. This is not all, for even culverts or bridges of small spans are also made of *mud*, a single arch of 10 to 12ft spanning the water's course from bank to bank at springings whose line is far above the highest water level. Nearly all the buildings in Persia are built of mud and sun-dried bricks ornamented with *gatch* or gypsum, and a short account of building and construction after the Persian fashion will not be out of place in your journal.

The principal materials which enter into the composition of a mud building are straw, quick lime, gypsum or *gatch* and stone pebbles. Any one desirous of having a residential house in or out of town, has only to give notice of his intention to the *Mehmarbashi* or the principal Architect of the city or town—generally a Persian—who either repairs to the party himself or deputes his assistant or *Bannabashi* to ascertain the size, style and description of the building required. This obtained, the *Mehmarbashi* or Architect prepares a plan which he personally takes to the *sahéb* and after explaining to him the general outside features and internal arrangement, and the cost probable, he leaves it to him to decide when, where, and how the house should be built. No building is started unless the day is auspicious—*rozikhair*—and when that day is determined upon, as also the size, style, &c., fixed by the future owner of the building, the *Mehmarbashi* is sent for and the *hukum* or order given.

Thereupon the builder commences operations. Brick-making being the first thing he sends his *falehs* or assistants to proceed with that work. The bricks are made of clay previously prepared. This is done by first digging the ground and allowing the clay to remain exposed for two or three days in the sun. It is then saturated with water and exposed for two days longer when it is subjected to the operation of *treading* or tempering. The clay is then moulded into bricks 9″×9″×2″, and the surface is luted over with water mixed with chopped straw or *kah*, of which 7 seers are used for every 1000 bricks moulded. This superficial plastering of straw is intended to prevent the newly made bricks from cracking. A single moulder can manufacture from 2000 to 2500 bricks per diem of 6 hours. The cost varies from 8 annas to 12 annas per 1000, and some times more when they are intended for the kiln.

When the bricks (sun dried) are ready, the *Mehmarbashi* marks the foundations according to the *rung* or plan, and the pits or trenches are then dug and the whole exposed for several days, generally one week, until the trenches and *debris* from the same are quite dry. The clay thus dug is of very tenacious character and is called *roost*, a kind of fire clay. The foundation is laid in with this clay mixed with quicklime. It is well treaded and rammed and then allowed to stand over for a week. The thickness of walls is determined by the weight and height of the superstucture and is invariably spoken of as so many *fingers* breadth. The walls are built with unburnt bricks and clay and the arches with the same bricks and *gatch* or gypsum. A *bannabashi* or a mason seldom uses the rule or plumb line when building a wall, his guide to straightness and verticality being the eye and the trowel.

The small arches—of which there are many varieties—are never built with centrings as in this country. It is sufficient when the first ring is made; all others follow it end-ways until the whole arch is completed in. It is made of a single brick on edge and kept in position in course of construction by means of the *gatch* and wedges of pebbles. The *gatch* dries as soon as applied on the edge of the bricks which are pressed or placed in position before it dries or *dies*. The pebbles are used as wedges only in the extradol joints of arches where the joint is wider than in the soffits. The circularity of the arch is determined by means of a line or string from the centre of a bar placed along the springing of the arch or rather span, or parallel to it, the said string being equal to the radius of the circle of which the arch is a part.

Where arches exceed 10ft in span and 30 or 40ft in length arched ribs are put in over centrings placed 10ft apart and the arch work of the spaces is filled in, as before, with bricks on edge—single—but without the help of centrings. Except in *tarbi* or extra strong arches where the bricks are used on their planes or flat, *i. e.*, endwise, all other kinds of arches, such as the *gabri*

or Parsi, which is never or seldom built without *shaloob* or centring; the *ālmaztrash* or diamond shaped; and the *ghace* or pointed—Gothic—are invariably built of single brick on edge.

When the arches or domes are completed the spandrils or *sandooghas* are filled up with broken bricks carefully arranged. Over this is laid fine loose earth which is rammed down to the required level preparatory to receiving the *khahgil* plaster which is prepared in the following, manner:—The clay, to which is added chopped straw, is first made and well tempered by the feet. It is then allowed to stand for several days with water just covering the top of the clay which is mixed in small tanks. When thus prepared it is laid over the loose earth which had been rammed level previously and thus the roof is completed.

The thickness of the *khahgil* plaster for the roof ranges between 3″ and 4″. After the roof is completed the parapet walls facing the streets and the neighbouring buildings are raised 5 and 6 ft. above the level of the roof, tapered, and similarly plastered with *khahgil*. The façade of the building is either plastered over with *khahgil* of finer quality coloured with red or yellow ochre and lined and panelled out in *gatch* or gypsum or entirely plastered with the latter and ornamented with mouldings of the same material. The interior of the building—the rooms—are generally plastered with *khahgil* of the finest quality called *sungil*, which is composed of fine clay, the husk of wheat, horse or cow dung, and the coloring matter. These are mixed in large vats and allowed to stand for several days—seven or eight days—when the clay is considered ready for use. It is then applied to the wall with a trowel, care being taken that it is uniformly laid. The projecting angles of walls and recesses are picked out in *gatch* and coloured to suit the *khah* or rather *sungil* plaster.

A single mason will lay in 2000 bricks for a day's work. When the wall rises beyond the reach of assistants or bearers of bricks and clay, the bricks are not taken up in hod or basket, but are thrown up from hand to hand to men placed on scaffoldings or stages until they reach the bricklayer. Leather gloves are worn by the throwers to save their hands from injury arising from the constant friction between the bricks and the palm of the hand.

Gatch is only used in building of arches or mouldings and is never mixed up in larger quantities than a few seers at a time when employing it as a cementing material or for mouldings. When in course of preparation for these works it is kept in constant motion to prevent it from *dying* or getting flat and therefore useless. The *gatch* is much appreciated for its quick setting and adhesive properties; it is the only and best cement used in arched masonry and mouldings.

The enclosure walls of the house are sometimes carried to great heights—30 to 40 feet—as a protection against thieves. They are built solid about ⅔rds of the height, the remaining portion being built in *sandooghas* or chambers which run along the length of the wall—generally of enormous thickness at the base and gradually tapering to a point or edge.

This is the *modus operandi* of building an ordinary dwelling house, and though the same method is observed in the construction of more pretentious buildings, public or private, the difference is only in the choice of materials. There are huge buildings three and four storeys high, built of sundried bricks faced with burnt bricks and the joints filled in with lime or fire clay and glazed green or blue. Vaulted bazars are entirely built of sundried bricks decorated with figures and flowers in gypsum. The perfection to which clay has been carried in the constructive art is evidenced in the former and the present capital of Persia by the magnificent caravanserai known under the name of *Carvanserai Mukhlis*; the buildings in *Charbagh* or four gardens; the public buildings in *Maidanishah*; and, last, but not the least the *Halfdast* or the Royal palaces, old and new.

ZULPAH.

SURVEY AND SETTLEMENT OF KAMRUP, ASSAM.

ASSAM has already proved itself to be one of our richest possessions, while the importance of its natural products has attracted considerable attention at home. The process of bringing this outlying province under a proper system of control has been going on for some years, and there is little doubt that before long we shall become fully acquainted with all its natural treasures. One of the civilizing influences at work in Assam is the survey. The annual report of Settlement operations during 1885-86 in connection with the Cadastral Survey of Kamrup, records some very satisfactory work done. The importance of a Cadastral Survey is too well known to need any detailed notice here. The absence of such survey for the Bengal Presidency is now so acutely felt, as to render the collection of agricultural and fiscal statistics a matter of extreme difficulty. It is, therefore, that the carrying out of a thorough survey in Assam will be viewed with much satisfaction as it will save much trouble in the future, and render the work of assessment of land revenue a comparatively easy task. The year under report was the third during which the Cadastral Survey was engaged in Kamrup, and the actual work of survey has now been brought to a close. This, however, does not include the revision survey, which is now being carried out, and which will be completed by the end of the current financial year. The Kamrup district comprises an area of 3,631 square miles, of which rather less than one-third, or 1,174 miles, has been covered by the Cadastral Survey and Settlement. This area lies wholly to the north of the Brahmaputra, and only 224 square miles on the south bank of that river have been surveyed. This was unavoidable, as the area excluded consists mainly of low inundated lands which make up the greater portion of the Barpeta sub-division and Chamaria tahsil, as well as the hilly country bordering on the Khasi Hills, and the great wastes which form the Bhutan Tarai on the north. Survey operations commenced in 1883-84 in the most populous and best cultivated portion of the district, lying between the Rangia and Nalbari, and gradually worked its way towards the circumference of the area covered. It can hardly be said that this was the best method of proceeding, as the result has been to increase the average size of the fields surveyed without decreasing the average cost of survey per acre. In 1883-84 the average area of the field, or survey unit, was 0·98 acre, which increased in the following year to 1·06 acre, while during 1885-86 it had reached a little over 2 acres. The cost of the work cannot yet be finally ascertained until the revision of the present year is concluded, and the operations closed. The financial results, however, of the first two years' work show at first a very substantial gain. Thus, in 1883-84 the increase of revenue amounted to over eight thousand rupees upon an ascertained area of 15,500 *beegahs*, while the cost of the survey and settlement was calculated at nearly a lakh of rupees, upon which the increased revenue would yield interest at nearly 8½ per cent. In the following year the increase of area was over 17,700 *beegahs*, and the revenue therefrom nearly Rs. 10,500; while the survey and settlement operations cost over a lakh and forty thousand rupees, yielding interest on the outlay at nearly 7½ per cent. This is, of course, very satisfactory, but in calculating the profits no allowance has been made for the ordinary increase of revenue, and the cost of the larger establishment necessitated by the Cadastral papers, which must all be deducted. Taking these matters into consideration, it is admitted that the increase of revenue, or gain to Government, is somewhat illusory, and the investment so far is not regarded as a profitable one. But it is a good sign to see that the Chief Commissioner views the prospective financial results of such a survey as of considerable importance. With the powerful checking agency, now for the first time placed at the disposal of the Divisional Officers, and an energetic district staff to supervise the work, considerable gain should accrue. In addition to this, there will now be an accurate basis for the collection of improved agricultural and other statistics, and a complete record of title and occupation furnished by the Cadastral maps. Thus, it is obvious that survey operations cannot but be regarded as an important factor in conveying into barbarous and semi-barbarous lands, the first lessons of civilization. Assam is a valuable possession; its natural resources are great and as yet undeveloped; and this point should be borne in mind when effecting Permanent Settlement.

J. H. J.

THE GEOMETRY OF THE OBLIQUE ARCH.

By A. Ewbank.

III.

Fig. 6.

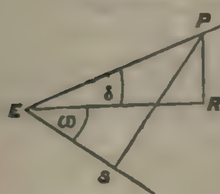
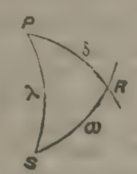
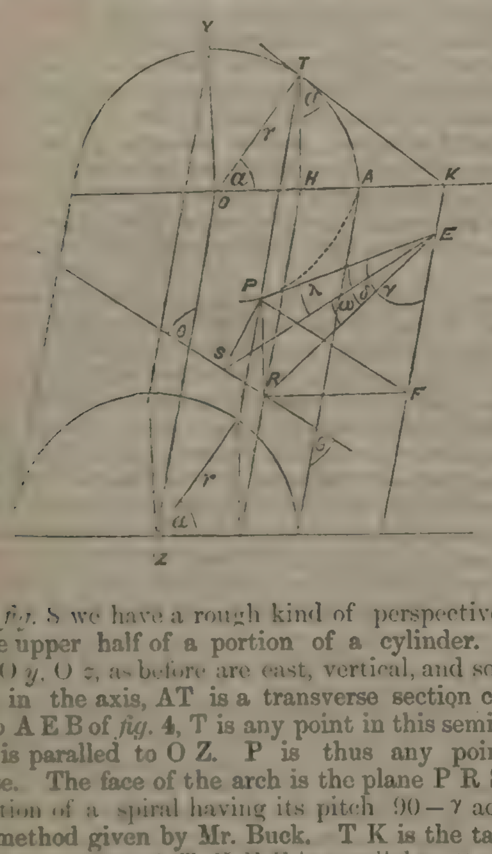


Fig. 7.



In *fig.*, 6 P E R is a vertical plane and R E S is horizontal. P R E and R S E are right angles. Then in the plane P S E we have P S E a right angled △ having P S E $= 90$, $\text{Cos P E S} = \frac{\text{ES}}{\text{PE}} = \frac{\text{ES}}{\text{ER}'} \frac{\text{ER}}{\text{PE}} = \text{Cos } \omega . \text{ Cos } \delta$. In *fig.* 7 this angle is shewn only by its arc P S. We may suppose P R, R S and S P to be arcs of great circles drawn on a sphere. The plane of P R is normal to that of R S. If the hypothenuse arc, so to say ω, δ and λ is called, λ we have $\text{Cos } \lambda = \text{Cos } \omega \text{ Cos } \delta$. These angles ω, δ and λ reappear in *fig.* 8 in corresponding positions.

Fig. 8.



In *fig.* 8 we have a rough kind of perspective drawing of the upper half of a portion of a cylinder. The lines O x, O y, O z, as before are east, vertical, and south. O is a point in the axis, AT is a transverse section corresponding to A E B of *fig.* 4, T is any point in this semi-circle and T P is paralled to O Z. P is thus any point on the ellipse. The face of the arch is the plane P R S. A P is a portion of a spiral having its pitch $90-\gamma$ according to the method given by Mr. Buck. T K is the tangent line to the semi-circle A T. K E F is parallel to O z. T P F K is the tangent *plane* to the cylinder at P or to any other point along the line T P. In this plane must lie the tangent line at P to any curve on the cylinder. P E is the tangent line to the spiral A P. The angle P E F is therefore γ. R S is the trace on the roadway of the oblique face, E S is normal to this trace. The inclination of E P to the face P R S is given by the angle E P S which we have to find in terms of θ, γ and the angle a which defines the position of P in its ellipse.

The radius of the cylinder is r.

In the *fig.* 8 we have $\text{Sin } \delta = \frac{\text{P R}}{\text{P E}} = \frac{\text{P R}}{\text{P F Cosec } \gamma} = \frac{\text{T H}}{\text{T K}} \text{Sin } \chi = \text{Cos } a \text{ Sin } \chi$ (1). $\text{E F} = \text{E P Cos } \gamma = \text{P R Cosec } \delta \text{ Cos } \chi = \text{T H Cosec } \delta \text{ Cos } \gamma = r \text{ Sin } a . \text{ Cosec } \delta$, $\text{Cos } \chi = r \text{ Sin } a . \text{ Sec } a \text{ Cosec } \gamma . \text{ Cos } \chi = r \text{ Tan } a \text{ Cot } \chi$. by (1)

$$\therefore \text{Cot R E F} = \frac{\text{E F}}{\text{R F}} = \frac{r \tan a \text{ Cot } \chi}{\text{H K}} = \frac{r \text{ Tan } a \text{ Cot } \gamma}{r \text{ Sin } a \text{ Tan } a} = \frac{\text{Cot } \chi}{\text{Sin } a}; \therefore \text{Tan R E F} = \frac{\text{Sin } a \text{ Sin } \gamma}{\text{Cos } \gamma}.$$

$$\therefore \text{Sin R E F} = \frac{\text{Sin } a \text{ Sin } \gamma}{\sqrt{\text{Sin}^2 a \text{ Sin}^2 \chi + \text{Cos}^2 \chi}} = \frac{\text{Sin } a \text{ Sin } \gamma}{\sqrt{1 - \text{Sin}^2 \chi + \text{Sin}^2 a \text{ Sin}^2 \chi}} = \frac{\text{Sin } a \text{ Sin } \gamma}{\sqrt{1 - \text{Cos}^2 a \text{ Sin}^2 \gamma}} = \frac{\text{Sin } a \text{ Sin } \gamma}{\text{Cos } \delta}$$

by (1). Similarly, $\text{Cos R E F} = \frac{\text{Cos } \gamma}{\text{Cos } \delta}$.

Now E S is perpendicular to R S; ∴ $\text{F E S} = 90 - \theta$ and $\text{Cos } \omega = \text{Cos R E S} = \text{Cos (F E S} - \text{R E F)} = \text{Cos F E S. Cos R E F} + \text{Sin F E S. Sin R E F}$ $= \frac{\text{Sin } \theta \text{ Cos } \gamma + \text{Cos } \theta \text{ Sin } a \text{ Sin } \gamma}{\text{Cos } \delta}$; ∴ $\text{Cos } \omega \text{ Cos } \delta = \text{Sin } \theta \text{ Cos } \gamma + \text{Cos } \theta \text{ Sin } a \text{ Sin } \gamma$. But as in *fig.* 6. $\text{Cos } \omega \times \text{Cos } \delta = \text{Cos } \lambda = \text{Cos P E S}$. This angle is the complement of the required angle E P S.

$\therefore \text{Sin E P S} = \text{Sin } \theta \text{ Cos } \gamma + \text{Cos } \theta \text{ Sin } a \text{ Sin } \gamma$.

The maximum value of the last found expression is found by making $a = 90°$. That is the nearest approach to 90° happens for that spiral which meets the ellipse at the summit. For this maximum we have $\text{Sin E P S} = \text{Sin } \theta \text{ Cos } \gamma + \text{Cos } \theta \text{ Sin } \gamma = \text{Sin } (\theta + \gamma.)$

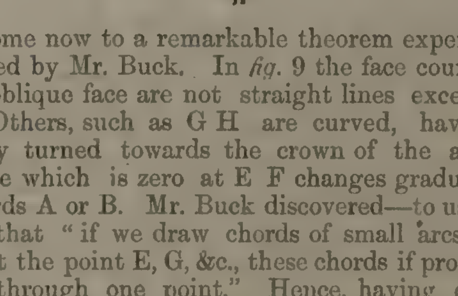
The construction of Mr. Buck gives $\text{Cot } \gamma = \frac{\pi}{2} \tan \theta$;

∴ Cot γ is greater than tan θ or $\gamma < 90 - \theta$ or $\theta + \chi < 90°$.

And the smallest value of E P S will happen for $a =$ zero.

Then $\text{Sin E P S} = \text{Sin } \theta \text{ Cos } \gamma = \text{Sin } \theta \text{ Sin } \beta$, as we found before. Thus this method gives *all* the angles acute angles.

Fig. 9.



We come now to a remarkable theorem experimentally discovered by Mr. Buck. In *fig.* 9 the face coursing lines for the oblique face are not straight lines except that at E F. Others, such as G H are curved, having their concavity turned towards the crown of the arch. The curvature which is zero at E F changes gradually as we go towards A or B. Mr. Buck discovered—to use his own words—that "if we draw chords of small arcs of these curves at the point E, G, &c., these chords if produced will all pass through one point." Hence, having drawn accurately any two curves, say E F, G H, and having thus determined the point R, in which the produced chords meet, the direction of the chord of a small arc at any other point, say B, is determined simply by joining R B.

This property he first suspected by the look of some drawings and then he verified it by having some more drawings executed on a large scale and with the utmost attainable precision. If, however, his draughtsmen could have put on the paper points visible but absolutely without magnitudes and could have drawn lines perfectly straight and *without breadth*, they would have *disproved* the theorem as stated for *chords* of arcs. But the theorem is absolutely true for the tangent lines at E, G, B, &c., and this, of course, Mr. Buck understood.

In giving a trigonometrical proof of the theorem in question—a theorem which is sometimes called the "rule of the focal eccentricity," but which would better be

defined by calling it simply Buck's theorem—we shall not at first limit the pitch of the spirals as was done by Mr. Buck. If the theorem is true for any "family" of spirals the usefulness of Buck's theorem is gained for any other pitch which an Engineer in constructing a bridge might prefer to adopt. Given a roadway over which a railway bridge is to be thrown, and given that the line of the railway had been already settled the obliquity of the bridge within narrow limits is *pre*-determined. This limitation could indeed be avoided by giving unnecessary width to the bridge. This would seldom be done.

If, however, the Engineer is helpless in the matter of obliquity it does not therefore follow that he is helpless in the matter of pitch, for the soffit coursing joints. If Buck's theorem is true only when the family of spirals are given, (what we will call) of the "Buck" pitch, then no doubt by the usefulness of Buck's theorem the Buck pitch will be consecrated. We shall next proceed therefore to inquire whether Buck's theorem is independent of pitch.

(*To be continued.*)

REPORT ON THE AURIFEROUS TRACTS, MYSORE.

(*Continued from Page* 220.)

Sonnahalli Series of Old Workings.

These workings commence about 2 miles to the South and slightly to the East of the village of Sonnahalli, the bearing which is 335° or 25° to the West of North from a pile of stones or station set up by me on a hill overlooking the village to the South. There is an almost continuous run of very large old workings for over 2½ miles South from Sonnahallibetta. Immense quantities of auriferous quartz and chloride containing silver must have been taken from this lode. as comparatively speaking very little now remains in the *débris* still left on the sides of these old workings. Judging from their present depth and from their great age, they must have been carried to a very great depth, the oldest inhabitants of the villages having no recollection of the times they were worked, nor have they even heard about them from their forefathers. The very fact of no trace of where the quartz was ground proves the old workings to be of very ancient date. We made very diligent search and enquiries as to where this process took place, but could find no trace, nor any information as to how the quartz was reduced to enable the gold to be extracted. We visited several ancient sites of villages, on which had been old forts, but no trace whatever of the reduction process by the ancients could be found. From this, I come to the conclusion that the reduction of the quartz must have taken place upon the outcrop of the country rock to be found every where adjacent to the old workings. But from the lapse of time the portions of the rock used for the reduction of the quartz have been weathered down by atmospheric influence. This sort of weathering down is very plain upon the Kolar gold fields. Bands of hard trap used for reduction purposes are so weathered down in the short space of 40 or 50 years that the whole of the hollows worn down in them during the reduction of the quartz from the mines are almost obliterated.

Karimuddenahalli Line of Old Workings.

I name this line of old workings as above for reference sake. The bearing from Karimuddenahalli to a large old working is 95°. This is one of the largest old workings that I have seen in India, and the largest perpendicular pit that I have seen. Its present depth from the top of the *débris* which surrounds it is about 50 feet. Its breadth North and South is about 60 feet and its length East and West being about 120 feet. Between this and another old working is a small bar of country rock left by the ancient miners from which I got the strike of the country, it being 18° West of North or 342°. The second old working is also very large lying close to the larger one to the West. A very fine reef of quartz is exposed in the North face close to the bottom, its breadth being about 18 feet. The quartz here is very massive, and no doubt the working had to be abandoned on account of the great strength of the lode, the ancients not being accustomed to the use of powder for blasting purposes, judging from the fact that no trace of drills or blasting operations are visible. The depth of this old working as it now stands is about 25 feet, length about 40 feet and breadth about 30 feet.

Judging from the immense mass of *débris* that is found round the pits and close upon their edges and the great age of these workings with their present depth, leads me to believe that they must have been carried down to a very great depth, as the constant filling in for many generations must have filled the pits considerably, and the large quantity of stuff removed from them now remaining on the surface proves them to have been of very great depth, and judging from what I have seen in other places, I would say these are the deepest ancient workings that I have seen through my prospecting trips in Southern India.

Another small old working in the same bearing exists about ½ mile South.

A quarter of a mile nearer to the village from the large old working commences a series of old workings running North 18° West to within ¾ mile of Dharmapura to the North. This is a continuous line of old workings for about 2½ miles. Deep excavations have been made right through, but apparently upon several lodes as they are found in several places at right angles East and West to each other. Immense quantities of auriferous quartz and silver chloride must have been taken from these workings, but where reduced for the extraction of gold and silver as in the former lode could not be ascertained.

A mile and a half to the North-East, we came upon 3 old workings which form a portion of the Sonnahalli series being in the same bearing and apparently on the same lode.

Near the village of Nadpanhalli to the North of it, are two shallow pits from where korundum has been taken and carried to Mysore for sale. The korundum here occurs in two forms, one as rock korundum and the other as cubical or in a more crystalline form, the rock carrying the cubes. The rock korundum is not a very fine quality, but still equal to the samples that I have had sent to me from England of American korundum valued at £44 a ton, the cubes of a more crystalline form being superior to the bane korundnm sent as samples to me from England and valued at £60 a ton. The country rock surrounding these is micaceous and hornblende schist.

I have reason to believe that the granite outcrop crossing the country 45° East of North near the village of Gagenhalli has cut off the gold for some distance to the North.

Mining in the Hunsur Taluk will be exceedingly cheap as fuel is in abundance and water plentiful. A road from Chetnahalli can be constructed at a very small cost as the country is most favourable for road-making, the distance being about 10 miles, or 20 miles from the Mysore Railway Station. Timber for mining and building is exceedingly cheap, the field being close to the large timber depôts at Heggaddevankote and Hunsur. Very fair bricks can be had at Rs. 3 per thousand also large potters' tiles at the same price. Granite can be had for building purposes at a distance of 10 miles, the length of carriage over a bad country track will make the price enormous. For special purposes only granite may be used.

On arriving at Berya in Yedatoré Taluk, I got information of asbestos being found near the village and had some brought for inspection. I proceeded next morning to examine the place and found asbestos in the excavated earth from the bed of the tank now forming the bund, and I am given to understand that it is taken out for the Mysore market when the tank is dry. The mineral is of a very fine quality, although the fibre is not long. I have reason to believe that good long fibrous abestos will be found in depth, but as it is in the bed of the tank any excavation to find it now would be quite out of question. The country rock here is fine argillaceous sandstone slate of the finest quality lying almost horizontal with a very slight incline of dip to the East. Small hornblende dykes strike from North to South along this portion of the country and stalactited hornblende quartz are to be found strewn all over the low hills lying to the East of Berya. We proceeded next morning to the village of Yedegaudanhalli on the Hole Narsipur road and then struck off South-West for about ½ mile, where we found a very large deposit of asbestos running about 2 miles wide. We traced it for about 2 miles North and South, its breadth East and West being 2 miles, and according to surface indications passes North and South along the country for an unknown distance. The country rock carrying this mineral is argillaceous earth slate with magnesian lime stone cap in sulphide and with talcose schist veins.

NOTES FROM HOME.

(From our own Correspondent.)

"PRINTING MACHINERY" was the title of a paper read and discussed at the last meeting of the Institution of Civil Engineers by Mr. Clowes. In this paper the successive and sequential stages are traced, which mark the development of printing from the little hand-press of four centuries ago to the power-press of to-day. The past and present printing machinery of the "Times" are noticed with much detail, and the descriptive accounts of several other special machines go to complete a record of the progress made during the last 70 or 80 years in a direction tending to promote, to a very large degree, the freedom, prosperity and happiness of the nation.

A paper on the "Shone Hydro-Pneumatic Sewerage System" was read by Mr. Ault at the last meeting of the Society of Engineers. The author laid down the leading principles of good sewerage, and after dealing with the difficulties of treating together sewage and rainfall, explained the objects and claims of the Shone system. The Pneumatic ejector was described, and three typical examples of the system were illustrated.

At the last meeting of the Telegraph Engineers a paper was read by Mr. A. E. Kennelly on the Resistance of Faults in Submarine Cables. In this paper very valuable experiments were described by the author of methods that were used in testing faults in submarine cables, and the paper evoked a discussion of considerable value and of high technical interest.

The prospectus of the new Incandescent Gas Light Company (Welsbach's system) has been issued. Several of the London daily papers hail this lamp as the "coming light" for brilliancy, purity, and economy.

Gas and oil are in competition in Waterford, where the corporation are not satisfied with the action of the Company, and have reverted to the use of oil for lighting the streets.

Wrought-iron pipes are being used for gas mains in New York by the Standard Gas Light Co. The Company intend to lay 30 miles of these pipes, and gas plant will be placed at different places, but without enormous holders. The gas is to be distributed at high pressure, and by the use of mains in 30 feet lengths, with gas-tight joint, the leakage (about 15 per cent.) of the New York Company's will be avoided. It is asserted that under a 1lb. pressure a 6" wrought-iron main will carry as much gas as a 16" main would under the system now in use. The gas intended to be produced is by passing the steam over incandescent carbon enriched with naptha.

The new Suspension Bridge at Hammersmith re-erected under the auspices of the Metropolitan Board of Works is to be opened by the Prince of Wales about the 20th of May, and it is arranged that upon the same day His Royal Highness will also lay the foundation stone of the new bridge at Battersea.

A new industry is being established in South Staffordshire in connection with the steel trade. A complete plant has just been laid down at the works of the Staffordshire Steel Company, Bilston, for the grinding of basic slag for agricultural fertilising purposes. A slag house 140 feet long by 50 feet has been built for the accommodation of the grinding machinery. The process is divided into three stages. The last completely pulverizes the slag making it of such a fineness that will pass through a mesh of 10,000 holes to the square inch. The slag being composed of 40 per cent. of lime and from 15 to 20 per cent. of phosphoric acid its value as an agricultural fertiliser is becoming increasingly appreciated.

Professor Tyndall's resignation of the chair of Natural Philosophy of the Royal Institution has been accepted with much regret, and to mark the Institution's cordial appreciation of his eminent merits, he has been nominated for election as Honorary Professor, a title previously borne by Sir Humphrey Davy and Professor Brande. One of the annual courses of lectures will be called the Tyndall lectures, and his bust is to be placed in the House of the Institution in memory of his relations with it. The resignation of Dr. Tyndall has called forth general expressions from throughout Germany, where he was esteemed as a physicist and had many personal friends.

A petition has been presented to the Queen in Council by the Dukes of Cambridge, Cumberland, and Westminster, and others on behalf of the Parkes Museum of Hygiene, and the Sanitary Institute of Great Britain, praying for the grant of a charter of Incorporation under the name of the Sanitary Institute. There will be, no doubt, considerable opposition to this from several influential scientific bodies.

The Great Eastern Steamship has been brought from Dublin to the Mersey where she will be a summer resort, a position she profitably filled last year.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Punjab, May 5, 1887.

Mr. T. B. Morris, Executive Engineer, 1st grade, Public Works Department, Punjab, is allowed two years' furlough, with effect from the 10th May.

Burma, April 30, 1887.

With reference to *Gazette of India* Notification, dated the 21st March 1887, Colonel C. M. Browne, R.E., Chief Engineer, 2nd class, made over, and Lieutenant-Colonel W. G. Cumming, R.E., Superintending Engineer, 3rd class, received, charge of the office of Secretary to the Chief Commissioner, Public Works Department, on the forenoon of this date.

With reference to Public Works Department Notification, dated the 16th April 1887, Mr. M. Birkbeck, Executive Engineer, 2nd grade, made over, and Mr. A. W. T. desA deCrettes, Executive Engineer, 2nd grade, received, charge of the Henzada Division on the afternoon of the 23rd April 1887.

Burma State Railway.

With reference to Director-General of Railways' Notification dated the 16th March 1887, Mr. W. H. P. Sherman, Executive Engineer, 1st grade, sub. *pro tem.*, reported his arrival at Rangoon on the forenoon of the 25th instant and is posted temporarily to the Engineer-in-Chief's office for duty.

Hyderabad, May 2, 1887.

Lieutenant E. Houston, R.E., Assistant Engineer, 2nd grade, has passed the Professional and Colloquial Hindustani Examinations.

Madras, May 3, 1887.

M. R. Ry. R. A. Srinivassa Aiyangar Avargal, B.A., B.C.E., Assistant Engineer, 3rd grade, is declared to have passed on the 5th April 1887 the Professional Examination prescribed in the Public Works Department Code.

The following promotion is made :—

M. R. Ry. R. A. Srinivassa Aiyangar Avargal, B.A., B.C.E., from Assistant Engineer, 3rd grade, to Assistant Engineer, 2nd grade, with effect from the 12th April 1887, permanent.

Bengal, May 11, 1887.

General.

Rai Madhub Chunder Roy, Bahadur, Executive Engineer, is appointed to officiate as Inspector of Local Works in the Burdwan Division, during the absence, on furlough, of Mr. L. R. Roberts.

Rai Madhub Chunder Roy, Bahadur, will also exercise the powers of an Inspector of Local Works in the Orissa Division.

Mr. W. P. Milne, Executive Engineer, Jessore Division, is appointed to officiate as Executive Engineer of the Rajshahye Division, *vice* Rai Madhub Chunder Roy, Bahadur, on deputation.

Mr. B. K. Finnimore, Assistant Engineer, temporarily employed on State Railways, is appointed to hold charge of the Jessore Division, *vice* Mr. W. P. Milne, transferred to Rajshahye.

Rai Haran Chunder Banerjee, Sahib, is transferred from the Jessore Division to the office of the Superintending Engineer, Western Circle.

The services of Mr. E. R. Gardiner, Assistant Engineer, Bhagulpore Division, are placed at the disposal of the Railway Branch for employment on the Northern Bengal State Railway.

Lieutenant-Colonel C. W. I. Harrison, R.E., Officiating Chief Engineer and Joint-Secretary to Government in the Public Works Department, officiated as Chief Engineer and Secretary in addition to his own duties from the 8th April to the 3rd instant, both days inclusive.

Railway.

Mr. W. Nicholson, Superintendent of Way and Works, Eastern Bengal State Railway, is granted 18 months' leave on medical certificate, with effect from the 12th May 1887, or such date as he may avail himself of the same.

Irrigation.

Mr. J. F. Williamson, Executive Engineer, attached to the Office of the Superintending Engineer, South-Western Circle, is appointed to hold charge of the Nuddea Rivers Division, during the absence, on leave, of Mr. C. E. Livesay, or until further orders.

Mr. A. Hayes, Executive Engineer, was attached to the office of the Superintending Engineer, Orissa Circle, from the 5th to the 12th of October last, both days inclusive.

India, May 7, 1887.

Mr. H. M. Mathews, C.I.E., Manager and Engineer-in Chief, Burmah State Railways, is permitted to retire from the service of Government, with effect from the 31st March, 1887.

Mr. E. W. Arundell, Executive Engineer, 3rd grade, State Railways, Officiating Deputy Consulting Engineer to the Government of India for Guaranteed Railways, Lahore, is confirmed in that appointment.

Honorary Lieutenant and Deputy Assistant Commissary W. T. Tobin, Supervisor, 1st grade, Hyderabad, is promoted to Assistant Engineer, 3rd grade, with effect from the 18th June 1886.

Mr. A. C. Cregeen, Superintending Engineer, 1st class, is granted furlough for eight months in extension of the furlough granted to him in Public Works Department Notification No. 26, dated 4th February 1886.

His Excellency the Governor-General in Council, having sanctioned a survey being undertaken of the river Chenab at Ramuwalla on the Sind-Sagar State Railway with a view to the selection of a site for a railway bridge at that place, Mr. R. T. Mallet, Chief Engineer, 3rd class, State Railways, is appointed Engineer-in-Chief of the project under the orders of the Director of the North-Western Railway.

Mr. J. R. Bell, Executive Engineer, 1st grade, State Railways, is appointed Superintendent of Way and Works of the Punjab Section, North-Western Railway, *vice* Mr. R. T. Mallet.

Colonel F. D. M. Brown, V.C., S. C., Executive Engineer, 1st Grade, North-Western Provinces and Oudh, is appointed to officiate as a Superintending Engineer, with effect from the 9th May 1887, during the absence on privilege leave of Colonel E. Swetenham, or until further orders.

Assam, May 7, 1887.

The unexpired portion of the three months' extended sick leave on medical certificate granted to Rai Sahib Gopal Chandra Chattapadhyay, B.A., Assistant Engineer, 1st grade, in Orders dated 11th April 1887, is hereby cancelled, he having reported himself for duty to the Manager, Eastern Bengal State Railway, on the forenoon of the 15th April 1887.

Rao Sabib Matadin Sukul, M.A., Apprentice Engineer, is, in the interests of the public service, transferred from the Cachar to the Sylhet district.

England has declined to participate officially at the Paris Exhibition in 1889.

NOTES FROM CHINA.—The merchants of Shansi have obtained permission from the Governor of the Province to establish a mining department similar to that in existence in Yunnan and Kwantung.

The Board of Admiralty strongly advocate the construction of a railway from Taku to Tientsin, thence Northwards to Shan Hai Kuan.

M. Carrey, a Lieutenant of M. Thevenet, the head of the French Syndicate, has been sent to survey the Yellow River, which is so plentiful a source of trouble and loss.

THE PAUMBEN CHANNEL SCHEME.—A new phase has come over the long pending Paumben Channel scheme. The works, it is rumoured, are to be undertaken by French and not English engineers. Since the completion of the Suez Canal, the French have always claimed the lead in work of a similar kind, and it would seem as if in the present instance they were going to cut out English Engineers.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

The 2nd May 1887.

81 of '86.—Sorabjee Muncherjee Rutnaggur, Apprentice Mill Manager in the Soonderdass Spinning and Weaving Mill Company, Limited, residing at Grand Road, Bombay.—*For life guard and automatic cleaner for tram cars.*

164 of '86.—Mathew Blake, of No. 6, Wellington Street, in the town of Greenock, in Scotland, Millwright and Engineer, and John Barclay, of Oakfield, East, in the said town of Greenock, also Millwright and Engineer, trading at the Victoria Works, Macdougal Street, in said town of Greenock, under the firm of Blake, Barclay and Company.—*For improvements in the manufacture and construction of Sugarcane Mill Rollers.*

179 of '86.—R. V. Schwarz, at Barrakur, Bengal.—*For improved arrangement for raising water.*

72 of '87.—William Jackson, Engineer, Thorn Grove, Mansfield, Aberdeen, Scotland.—*For improved means for securing tubes in the tube-plates of air heating apparatus or the like.*

Notices.

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CONTENTS.

Obituary.

HACKMAN.—At Dera Ghazi Khan, on the 6th May, from the effects of snake-bite, H. R Hackman, Assistant Engineer, Pishin Road, Public Works Department, Punjab.

INDIAN ENGINEERING.

SATURDAY, MAY 21, 1887.

THE DIRECTOR-GENERAL OF STORES, INDIA OFFICE.

AN Indian Budget without the Home charges is like the play of Hamlet with the part of the Prince omitted. It is one of the prominent items which help to swell the deficit in the Financial Statement. A huge establishment is kept up in England at the cost of an alien race, ostensibly with the object of benefitting it, but in reality for serving the friends of the party that is in power for the time being. Its tendency, moreover, is to expand, and we may say, without fear of contradiction, that it shows no symptoms of having yet reached a limit. No wonder, then, that the country looks upon it as a grave scandal, while publicists find in the India House jobbery a subject prolific in pabulum for their readers, and persistently return to the charge as occasion demands. The accusation is grave enough without the additional indictment of gross extravagance and mismanagement, as we will presently show.

Of all the branches connected with the India Office the greatest offender in that respect is the office of Director-General of Stores. Glaring inconsistencies exist here, the continuance of which cannot be accounted for on any other hypothesis than that the men in authority should lend a helping hand to their friends at the expense of India. Let us take one out of many intances that will readily suggest themselves to the reader. In a Government of India Resolution, P. W. D., the following significant passages occur :—" I am to invite your attention to paragraph 3 of Finance Department Resolution, No. 185, dated 10th January 1883—p. clviii., under which English stores may be purchased in this country, and to state that, whenever English stores are authorised to be purchased locally, the reasons for allowing the purchase must be placed on record, as well as the probable estimated loss or gain caused by adopting such a course . . . . I am further to point out that, under the rules in force, the purchase of English stores by means of orders given to agents or firms in India, who have to send such orders to England for execution, is absolutely prohibited. If any case of such a nature should occur, it should be seriously noticed and should be forwarded, together with the orders passed thereon, to the Government of India for information."

Before proceeding further we would here premise that where permission is accorded to purchase English goods locally, it is restricted to the sum of Rs. 10 ! ! But the second clause is the most damaging to the cause of the advancement of India. Now it is an acknowledged fact that there are large and respectable firms throughout the country who have invested immense sums of money in procuring railway and other stores that may be required for immediate use, but who, by reason of the order referred to above, do not any longer import such goods, much to the

detriment of the public at large. The advantages of obtaining these requirements in India are so obvious that it is a matter for surprise that the system adopted at present should be permitted to continue even for a single day. In the first place, they can be purchased much cheaper, and the incidents of freight, insurance, landing charges, &c., are thereby saved to the State. In the next place, the delay that must necessarily occur in the execution of an order in England ought of itself to be a sufficient consideration in favour of making the purchases here. It is an admitted fact that indents ordered out from Home take from six to eighteen months in reaching their destination; this means needless stoppage of work, and, perhaps, the loss of a season, which might tell seriously upon the progress of a bridge or other extensive undertaking. In one instance, in Madras, some theodolites were ordered from England which did not come to hand till a year and a half after the requisition was made. The consequence was delay in the prosecution of the survey and a heavy loss to Government in money, during the time the surveyors were drawing their salaries and doing comparatively nothing, in expectation of those useful articles coming out from Home—to say nothing of the loss of time, which is an important element in a work of that description.

The laying of an embargo on local trade operates prejudicially to the real interests of the country. Purchasers of articles from local firms know exactly their wants and if permitted to make their choice in India can suit themselves to a nicety. Whereas goods obtained from a distance, guided by mere description, may be unsuitable and the chances of replacing them are reduced to zero. On the other hand, local firms have a reputation to sustain, and are in honour bound to supply the best articles at moderate rates in order to encourage consumption, with the full knowledge that any shortcomings in this respect will entail loss of customers, which alone is an inducement to them to act up to the terms of the contract. But all these safeguards are removed in the case of firms that have no personal interest in the matter beyond the mere letter of their engagements. There is another advantage to be gained by encouraging local purchases. A stimulus is given to private enterprise and the public benefit indirectly. Local firms have succeeded in introducing iron goods in the Indian market and in creating a demand for British manufactures. There is hardly an edifice of any pretension now erected that is not the better for such improvement.

But it is a moot point how long such a state of things will last. Government having withdrawn its patronage from Indian firms these could not regularly import goods, whether for use or decoration, which would command a sale only in a very limited market. The precariousness of the demand suffices to lessen their supply, if not to altogether shut them out. This is a serious question indeed, and if our native fellow-subjects would leave alone the reconstitution of Legislative Councils and such claptrap, and devote their attention to the removal of these drawbacks from the paths of India's material progress, they would be entitled to the lasting gratitude of the people.

There is, however, another point intimately connected with the present discussion. Every now and again we hear of Government circulars enjoining the heads of departments to encourage local manufacture by purchasing goods in the market here, if they are procurable cheaper or at the same price as English articles. This is a mere blind, for, with the exception of country paper, produced in the Bally Mills, which is largely patronized, there is not another item or requisite that is bought in the country. Of course, a little stir is made for a time, somebody temporarily earns cheap popularity, and then the whole thing slides down into oblivion, till the next patron of indigenous manufactures comes forward to create a nine days' wonder. This is the way how the country is governed, whlle India for the Indians is the watch-word of our patriotic Radicals.

PREVENTION OF THE WASTE OF WATER.

THE letter addressed to the Town Council on the prevention of waste of water, by Mr. E. C. K. Ollivant, Municipal Commissioner for the Town of Bombay, based on the Report of Mr. Tomlinson, Deputy Executive Engineer, Water Works Department, which we are producing in this Journal, is a model despatch, whether we take into account it concisenesss, lucidity, or the ability with which the subject is handled. One of the main points of discussion is, what to many will appear a paradox, that constant distribution of water-supply possesses great advantages over intermittent distribution in the long run. But that is not all. The latter system, as Mr. Tomlinson points out, is attended by three drawbacks, visible leakage due to negligence, invisible leakage due to bursts, and the deterioration in the quality of the water. In regard to the first point, it is said that the supply is cut off when the demand is at its full height, and as the taps are kept open till the water is again turned on, there is, consequently, a good deal of waste. The invisible waste, on the other hand, is caused by the mains being charged twice a day with air, so that when the water is again permitted to flow, a compression is the immediate result, causing leakages in places difficult to discover. The more serious evil, however, is the deterioration which the quality of the water undergoes owing to contact with impure air in the pipes in the intermittent system, which could not occur under the constant supply system, as there is no possibility of access of air, the pipes being always full of water. There is also another advantage to be derived in case of fire occurring, when the accidents from a failure of water under the intermittent system, are altogether removed.

Mr Tomlinson has carried out a number of experiments in connection with the subject and has arrived at the conclusion that, if careful supervision is exercised, there need be no apprehension of a greater consumption of water under the constant supply system. Mr. Tomlinson puts his theory to the test in two separate localities in Bombay, and the result more than realised his expectations. In one street alone the extension of the

hours of supply from seven to twenty-four hours, doubled the consumption for the first few days, but when it was submitted to careful inspection, for close upon two months, the discovery and remedy of leakage, it was found that, notwithstanding a constant supply to the districts treated, the total local consumption was, generally speaking, reduced to its former limit. Thus, "when the supply was intermittent the daily consumption in the abovementioned street was 11,700 gallons in seven hours, being at an average rate of nearly 1,700 gallons per hour, and with the supply constant the daily consumption at the end of seven weeks' inspection stood at 11,832 gallons in twenty-four hours, being at an average rate of 425 gallons per hour."

There is another point to which Mr. Tomlinson directs attention and that is the garden consumption of water, which should be made the subject of separate charge. He adduces facts and figures to show that consumers who actually pay for this necessary of life, are charged at the rate of four annas per thousand gallons. But there is some anomaly in the way in which premises are assessed: "A bungalow with a garden attached is at present assessed at the same rate as one with no garden," consequently the amount consumed by the former must, as a matter of course, be much greater than in the case of the latter. Mr. Tomlinson had some meters placed in gardens which, on examination, showed that in those localities the consumption was 100 gallons a head, whereas in districts where there are no gardens, the consumption varies from 14 to 19 gallons per head. Mr. Tomlinson would, therefore, make a charge for each garden tap, since it could not legitimately be included in the term 'domestic supply,' and what is more to the purpose, each of these garden-houses causes a loss to the Municipality—a loss of Rs. 100 per annum. Intimately connected with this subject is the supply of water, at a nominal rate, to charitable institutions, where the discrepancy is still more glaring. For instance, the Jamsetjee Jeejeebhoy Hospital and the Grant Medical College absorb between themselves 8,313,930 gallons per annum, at a nominal fee of Rs. 3, which means a loss, during that period, to the Municipality of Rs. 2,075.

Owing to the limited space at our disposal we are precluded from examining minutely the details of the scheme put forward by Mr. Tomlinson, but we would earnestly advise the Calcutta and other Municipal Corporations to carefully peruse the Report we are publishing in connection with the water-supply of Bombay.

PUBLIC HEALTH IN A NATIVE TOWN.

KUMBACONUM—sometimes known as the Cambridge of Southern India—appears to be in a bad way as regards Sanitation. It is one of the largest towns in the Madras Presidency, situate close to the Cauvery and Arsillar rivers in the Tanjore District. The site possesses the prevailing level and alluvial character of most deltaic areas, but with the additional disadvantage of the surrounding country being wholly irrigated and under water during at least six months of the year. The population is upwards of 50,000 souls, but there is a constant influx both of traders and pilgrims, as the town is considered one of the most sacred in that part of the Peninsula and the Cauvery particularly holy in its neighbourhood. It has long been noted for its insanitary condition, and the history of the remedial measures contemplated but never carried out is characteristic of other places besides this one which is typical of Madras. There has been report upon report with no practical result. The problem to be solved is the common one—*viz.*, the best means of disposing of the drainage and sewage of the town—the difficulty anent which lies in the physical disadvantage adverted to. It is acknowledged by the local authorities that any effective drainage scheme will necessitate *pumping* the requisite water for flushing purposes. Under these circumstances would it not be advisable to examine the applicability of the "Shone Hydro-Pneumatic System of Sewage" towards meeting the need? The advantages of this system were set forth in a leading article of the first issue of this journal, and we afterwards gave the complete project for the sewerage of Rangoon by the same means. It is unquestionably the best sanitary improvement of the day for overcoming deficiency of natural gravitation—that is, the very difficulty that obtains at Kumbaconum. Judging from the Official Correspondence on this subject, we are disposed to agree with the view that the great want of Madras at present is a Sanitary Engineer to formulate and put into practical shape the suggestions of the Sanitary Commissioner.

FOREST OF DEAN PIG-IRON.

TEN years ago there were twelve blast furnaces in operation in the Forest of Dean, England, but now there is only one. Some three hundred tons of pig-iron per week is all that is produced, and judging by the accumulated stock even this insignificant quantity is not very easy to sell. It is not because "Forest" pig is of worse quality than formerly. But because of the development of other districts or localities, notably Cumberland and north Lancashire, and Bilbao in the north of Spain. The forest ore is a brown hematite, and so is that from Spain. The ore from the Cumberland district is, on the other hand, a red hematite. There is not much difference in the quality of the resulting pig-irons. Forest pig has, however, one remarkable peculiarity, which specially fits it for foundry purposes. It is much softer than any other brand, whilst at the same time it runs with great fluidity and contracts very little in cooling. These good qualities are due to the small proportion of manganese, silicon and sulphur which it contains. Phosphorus is also low, though not relatively so low as the other ingredients mentioned. The softness of Forest pig-iron will be realized when the fact that the pigs will actually bend before giving way under the breaking hammer is understood and appreciated. No other known brand of pig-iron exhibits this peculiarity.

Notes and Comments.

THE FOREST DEPARTMENT.—A circular has been issued to all Conservators of Forests in the Punjab regarding the utilization by the Forest Department of portable tramways for the carriage of timber and firewood.

THE CONSULTING ENGINEER'S OFFICE, CALCUTTA.—Colonel C. H. Luard, R.E., Consulting Engineer, has gone on six months' leave, and Major W. H. Coaker, R.E., Deputy Consulting Engineer, from Madras, officiates for him. Captain Buchanan Scott, R.E., has also taken up his duties in the same Office.

BOMBAY P. W. D. SECRETARIAT.—Major F. Firebrace, R.E., is confirmed in the appointment of Joint Secretary to Government for Railways. Mr. W. C. Hughes, M. Inst. C.E., acts as Secretary to Government, with effect from the 1st April 1887; and Mr. W. H. Le Quesne acts as Under-Secretary to Government, *vice* Mr. Hughes.

COAL TRAFFIC—RANIGUNJ.—The total despatches of coal from the various railway stations in the Raniguuj Sub-Division of the Burdwan District, during the financial year 1886-87—just closed—were 783,517 tons as against 598,794 tons in the previous year, shewing an increase of over 25%. This progress is worthy of attention.

BENGAL-NAGPUR RAILWAY.—We learn that Mr. H. Groves, Executive Engineer, 2nd grade, P. W. D., who carried out the Katnit—Umaria Section of the Bilaspur-Etawah State Railway, has been appointed District Engineer of the Eastern end of the Bengal-Nagpur Railway. Mr. C. D. Berrill has also been appointed Assistant Engineer in the same district.

OPENING OF THE VICTORIA BRIDGE AT CHAKI-NIZAM.—The Lieutenant-Governor of the Punjab opened, on 16th May morning, the newly-erected bridge over the Jhelum at Chaki-Nizam by testing the last rivet driven in. In a short speech His Honor christened the bridge as the Victoria Bridge. The entire ceremony passed off without a hitch, the day being very pleasant on account of the sky being cloudy.

TECHNICAL JOTTING.—Mr. Jno. Jas. Webster, M. Inst. C. E., from experiment has framed the following emperical formula to ascertain the horse-power requisite to dredge different material under different circumstances:—If H be the height of the top tumbler from the surface of the ground and W the number of tons to be dredged per hour, then,

$1\ H\ P = 0{\cdot}040\ W\sqrt{H}$ for very stiff clay or mud.

$= 0{\cdot}034\ W\sqrt{H}$ for hard clays and indurated mud.

$= 0{\cdot}026\ W\sqrt{H}$ for soft mud and light sand.

GOLD MINES IN CHINA.—The Pingtsuey Mines have started the first quartz-crushing machinery in China; thus initiating the first commencement of practical gold mining on foreign methods in that country. This first attempt at Chinese gold mining has, however, but imitated the common error of many such pioneer enterprises all over the world, in neglecting the main and essential work of underground development, whilst rushing ahead with the erection of costly machinery and other accessories, which should follow the establishment of a more or less permanent mine.

HONOUR TO WHOM HONOUR IS DUE.—It was, without doubt, an unfortunate circumstance that the Duke of Connaught, in opening the Chupper Rift Tunnel on the Sind-Pishin Railway, should have described the work as another monument to the skill of the Royal Engineers,—a Corps with which he was proud to be connected, &c., &c. The tunnel was constructed entirely, from start to finish, by Civil Engineers; and Mr. G. P. Rose was the Executive Engineer in charge of the work. But we suppose it is only right that Brigadier-General Browne, R.E., should take all the glory.

NATIVE SUBMARINE MINING CORPS.—In accordance with instructions received from home, the officer in charge of the Royal Engineers in Ceylon has been instructed to enrol a company of natives in Colombo for service in Trincomalie, in connection with the work of the laying of torpedoes about to be undertaken at that port. Forty men, have been selected for this service, out of a large number of applicants, and will shortly be enrolled. We believe there is already a company enrolled at Singapore, and others are in process of formation at other stations in the East. The various companies will be formed into one corps, wearing the same uniform, to be called the Eastern Battalion of the Royal Engineers.

THE NIRA CANAL.—This gigantic scheme is now in active progress. Already 70 miles of canal have been opened for irrigation. Although the financial pressure reduced the expenditure on this undertaking, still about 4 lakhs of rupees is yearly spent upon it. We learn that the main weir at Veer Vadi is practically completed. This weir is half a mile long, and varies from 35 to 50 feet in height. The subsidiary weir which is to compound a water cushion below the main weir is also completed. But the reservoir dam at Butghur on the Yelwardi, a tributary of the Nira river, is only half built. The lake will be 19 miles long and will hold 5,500 millions cubic feet of storage. There are 30 miles more of canal to be made.

STATE RAILWAY OFFICERS.—A recent number of the *People's Budget* contains a thoughtful and temperate article on the officering of State Railways. It is unsparing in its comments on the system in vogue at present, and as the writer must be credited with possessing a knowledge of the subject he is dealing with, we cannot but concur in the views enunciated. He says that in a great many cases appointments are made on the score of social claims only, little or no regard being paid to administrative and intellectual qualities in the nominee. The result is that subordinates, who naturally look for guidance and instruction to their officers, are disappointed, and the entire system is consequently in a jumble.

WORK AND WAGES FOR INDIA ARTIZANS.—We glean from a Bombay paper that Bombay workmen are learning—or mislearning—the English trades-union theories too readily, and are applying them too freely, while the trade of that city is not yet robust enough to stand it. It is useless for a native to try and claim wages in India corresponding to those that a European can earn at home for he does not and cannot work so hard, at all events in the heavier trades. Moreover, the trades-union principle must not be pressed too far in Bombay. It works well enough in England and America, for the workmen there are a necessity to the world, and they govern their prices by quality and also by competition. But even there the Germans are running them close with their low wages, long hours, and cheap food. Still the world must have British manufactures as long as they keep within practicable limits, but the world has no absolute need of Bombay as a manufacturing town.

H. H. THE NIZAM'S GUARANTEED STATE RAILWAY.—On the 17th July 1874, the first Railway in the State, from Wadi to Hyderabad, a distance of 121 miles, was opened for traffic, and on the 3rd April 1886, the extension to

Warangal, a distance of 87 miles, was completed by the Nizam's Guaranteed State Railawy Company and also opened for traffic. The existing Railway from Secunderabad to Wadi was in May 1885 handed over to the new Company. The Railway system either constructed, in process of construction, or contemplated, comprises a total length of 493 miles, of which 208 miles from Wadi to Warangal are open for traffic, 69 miles to the Singareni Coalfields are under construction, and a further distance of 76 miles from Dornakal to Baizwada will be constructed later on. The concession to the Nizam's Guaranteed State Railways' Company also embraces the construction of a line northwards, from Kazipet to Chanda, about 160 miles in length.

The Superintendent of Works, Calcutta.—A short time ago the *Indian Daily News* alluded to the necessity of reducing the number of the Calcutta Divisions, and abolishing the present costly appointment of Superintendent of Works. The three Calcutta Divisions only exist on paper, as Colonel Neill has for some time past done the work of the 3rd Calcutta Division in addition to his own duties. As soon as the Government Roads in the Presidency Division are handed over to the District Board, the 3rd Calcutta Division will probably be amalgamated with the 2nd, thus reducing the number of P. W. D. Divisions in Calcutta by one. The suggestion of the *Indian Daily News* to abolish the Superintendent of Works is not feasible, as that Officer, in addition to the work in Calcutta, has to supervise the Seebpore Workshops, the Akra Brickfield Division, and the Burrakur Iron Works; so that unless a new Superintending Engineer be allowed in Bengal, it is difficult to see how the work can be carried on, if our contemporary's proposal be adopted.

Thrift on the Railways in the Madras Presidency.—The question of reducing expenditure in the cost of permanent way materials for railways is at present engaging the serious attention of the Railways in the Madras Presidency, and in lieu of the present Ibbotson's patent fishbolts, which are found to slacken, the Madras Railway Company have indented, as an experiment, for Grove's patent washers for a length of 10 miles. The South Indian Railway Company at the same time are making vast experiments in the use of 50lb. rails for heavy work. The Government of India are meanwhile not idle in the matter of reducing expenditure in other directions, for the Railway Companies in that Presidency have been requested to limit their stock of locomotives by keeping the engines longer in steam than at present, and thus getting more work out of them. The drawback anticipated, should this proposal be adopted, is that the responsibility of keeping the engine in order, consumption of fuel, &c., will be divided by more than one driver, and thus lead to difficulty.

The Sukkur Bridge.—The bridge over the Indus at Sukkur should be ready to receive trains by the middle of next year if the India Office bestirs itself and gets the ironwork for the large span on the cantilever section forwarded out without further delay. The contract for this span, which alone cost between £30,000 and £40,000, has been "placed" in England and the contractors have been urged to use the utmost expedition in completing their work. It is hoped that the ironwork will reach India by November of the current year, in which case it could be placed in position during the cold weather of 1887-88. The section of the bridge over the Sukkur Channel, linking the island of Bukkur with the west bank of the Indus, has been completed some time. It consists of two spans of 270 feet and 230 feet and one of 90 feet. When the whole bridge is opened for traffic the last link in the main line of our frontier communications will have been forged; and as the Sind-Pishin Railway will about the same time begin to be practical, we shall be able to turn our eyes with confidence towards Kandahar and distant Herat, where the clouds of war may still arise at any moment.

Indian Railways.—Mr. H. Bell, Manager of the Tirhoot State Railway, has contributed a paper on this subject, to the last number of the *Asiatic Quarterly Review*. The writer has thoroughly succeeded in exploding certain popular fallacies which should command the serious attention of the travelling public. Mr. Bell has conclusively proved, by the result of the late reduction in fares on the Tirhoot line, that although class tickets in this country are cheaper as compared with Europe, yet considering the means of the mass of population it is not so, and it follows as a corollary that the smaller the rates the larger the profits. Then with regard to the question, which pays more—passenger or goods and merchandize traffic—it is satisfactorily solved by Mr. Bell. He quotes statistics to shew that in 1845 "it was supposed that the profits of railways in India would mainly be derived from the carriage of goods and merchandize, and that the passenger traffic would be small. The experience of the first twenty years shewed that the conveyance of passengers was most lucrative, while the returns of the next two decades proved beyond doubt that the reverse was true." The receipts in 1885 from goods traffic were 119 millions of rupees, and from passenger traffic about 55½ millions. Owing to want of space we cannot enter into a more lengthy examination of the more salient points of review, and we would advise our readers to look into the article themselves and realise its value.

A Crematorium for Calcutta?—The question of the Circular Road cemetery is becoming a very pressing one. At present the Church of England part of the ground is filling so rapidly, that there is only space left for another ten or twelve months. The plots allotted to the Roman Catholics and other denominations will, however, not be filled for two and two and a half years, respectively according to the present rate of the interments. The question of extending the cemetery eastwards as far as the Jannuggur Road, and southwards as far as the Kurryah Bazar Road, has already been discussed by the Burial Board, and is now under the consideration of the Local Government. The cost of this scheme will be about 6 lakhs of rupees, and, on sanitary grounds, it is objected to by nearly all the residents in the vicinity. The Board further went into the question of establishing a cemetery some distance away from Calcutta but the idea had to be abandoned on account of the expense which would have to be incurred by the poorer classes of Christians, who are already sufficiently burdened with the heavy charges made by the undertakers. Sir Henry Harrison suggested that a crematorium should be established, and although the members of the Board, (who are nearly all clergymen,) almost shrieked with dismay at the very thought, it is at least an open question, whether many people in this country would not prefer to be burnt after death, rather than allow their bodies to infect the air and the ground.

Current News.

It is believed that a paper mill will shortly be started in Travancore.

It is said that the Bilaspur-Etawah State Railway will shortly be extended from Umaria to Sohagpur.

The survey for the new Jubilee Water Works at Jammu is said to be nearly completed, and operations will be commenced shortly.

There seems little likelihood of the Short's Island Lighthouse at the mouth of the Dhamra River, Orissa, being finished during this working season.

Government have sanctioned the payment of an honorarium of Rs. 1,800 to Mr. Pogson on the completion of a volume of Madras Meridian Circle observations.

Mr. Upcott succeeds Mr. Ramsay as Engineer-in-Chief of the Sind-Sagar Railway. This line will shortly, on completion for traffic, merge in the North-Western Railway.

Every effort is being made by the Engineers to re-build the damaged sluices of the Mahanadi Anicut during this month, to enable the canals to be re-filled on the 1st June, as advertised.

As the Sukkur Bridge is not likely to be completed for two years or more, the question of increasing the steam ferry accommodation at the crossings over the Indus is under consideration.

We are sorry to know that Mr. Franklin Prestage, the Chairman of the Darjeeling Himalayan Railway (as well as originator of the enterprise), has been obliged to leave India for a change Home.

Mr. Wallace, the Professor of Agriculture of the Edinburgh University, is expected to arrive in Bombay by next mail. Mr. Wallace is coming to this country to make a study of Indian agriculture.

Of the twenty-four jute mills in India, the Madras Presidency possesses only one, and that (a small one) is at Vizagapatam. But that Presidency is better off in this respect than Bombay, which has none at all.

Jaipur has been the scene of a serious fire, which destroyed nearly seven hundred houses, such as they were. There was also some loss of life. The Durbar granted five rupees each to the houses burned down.

The railway line from Guntakal to Bellary, with its working staff, has been handed over by the Madras Railway Company to the Southern Mahratta Railway, and the latter Railway has commenced to work this line from the 15th instant.

A new Company, called the "Madras Metal Trading Company," has been started with a capital of two lakhs of rupees, in one thousand shares of two hundred rupees each. Almost all the shares have been taken and the Company duly registered.

The Simla-Kalka Railway papers have been sent to Colonel Conway Gordon for early report, as a commencement now likely for closing finally the question of the Simla location, since the Railway revenue will depend solely on the passenger traffic.

A Bombay paper hears that Sir George Birdwood is engaged on an important work on Indian Art. It will be a book of considerable dimensions, and will probably take a front place amongst works on a subject which Sir George Birdwood has made his own.

On May 18, His Honour the Lieutenant Governor of Bengal laid the foundation stone of the Hindoo Hostel west of the Senate House, Calcutta. There was a large gathering under a large *shamiana*, the streets on both sides being gaily decorated with flags and greenery.

It is reported that the Madras Railway Calicut Extension will not be ready for public traffic before the end of the present year, owing to the many station buildings, &c., which will have to be completed, especially for goods and locomotive accommodation, at the future terminus of Calicut.

The Indian silk industry is now in a fair way to make good progress, the merchants interested in it having heartily welcomed the action taken by the Government of India to assist them in their trade. The Revenue and Agricultural Department are making a collection of all the various Indian cocoons, which will be sent to Manchester, there to be kept always open to inspection.

We learn from an official source that the contract entered into by Messrs. Streeter for the working of the Ruby Mines of Burmah, the terms of which were provisionally agreed to so far back as November last year, has been finally sealed and ratified. The annual payment is fixed at four lakhs, and we understand that the original duration of the lease—five years—has been extended.

Mr. Geoghegan, the Engineer-in-Chief of the Madras State Railway Surveys, who was in Madras last week, has just laid before the Consulting Engineer for Railways his report, accompanied by plans and estimates, of the survey of the proposed line of Railway from Madras to Paumben, which, it is understood, will eventually form a part and parcel of the South Indian Railway system.

Mr. H. B. Hackman, an Engineer of the Public Works Department in the Punjab, who was lately reported to have had his hand cut off to escape the effects of a bite from a poisonous snake, has died. Mr. Hackman had served only three years and a half in the Public Works Department, and had held the rank of Assistant Engineer of the 1st grade at Dera Ghazi Khan only since last November.

With the view of providing greater facilities at the Madras Pier for the working of cargo, it has been decided, in accordance with a suggestion made by Captain Taylor, to extend the pier-deck laterally from the gangway ladders outward to the T end sufficiently to allow of the small half-ton cranes being placed outside the present line of the Pier, the deck so extended being suitably supported from underneath.

Work is being pushed on at great speed at the new Viceregal palace now under construction at Observatory Hill. The whole of the massive iron girders have been placed in position and the trusses are now being adjusted. It has been decided to roof the building with tiles similar to those used at the new Town Hall. The building, it is hoped, will be finished by the end of May next, but will not be fit to live in for fully a year longer.

In the Financial Budget of the Public Works Department of Bengal, the Government has greatly reduced the allotments for temporary work, and in the permanent establishment of the Department, the number of Engineer and subordinate officers and assistants is considered more than enough for the purpose. It will not therefore be surprising to find that, to effect savings, Government will reduce certain executive divisions, abolishing them, or amalgamating them with the adjoining divisions.

Mr. Housden, has written from Kontaung saying he had been obliged to stop work on the surveys of the Tamu-Chindwin road on account of the want of water on the higher spurs of the hills, and was engaged in making out plans and estimates to allow of regular work being commenced when the rains are over. He is of opinion that the cart-road will cost no less than seven to eight lakhs of rupees, and that a mule track, 12 feet wide would cost four lakhs, and he thinks the road will take some years to complete.

The undertaking of the Indian feeder lines Company is making progress. A tender for the whole of the plant, rolling-stock, &c., delivered in Bombay, has been submitted by Messrs. John Fowler and Company, of Leeds and Calcutta, for the sum of Rs. 56,130, and has been accepted on the understanding that the order will be given in the event of the lease being executed in terms satisfactory to the directors. Messrs. John Fowler and Company undertake to make delivery in Bombay within twelve weeks from the date of order.

Major W. Shepherd has been appointed to succeed Colonel Wallace as Consulting Engineer to Government for what will henceforth be called the Central Division, comprising the Indian Midland and Bengal-Nagpur Railways. Major Shepherd is a Superintending Engineer with 23 years' service in the Public Works Department. He was four years Deputy Consulting Engineer and Consulting Engineer, besides two as Engineer-in-Chief of railways under construction, and he has spent the last two years in hard and trying work on the Sind-Pishin line.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

A COLLISION IN THE HOOGHLY.

Sir,—It may interest some of your readers to learn that during the storm of the evening of the 2nd May at Calcutta a collision occurred between the ships *Thirlmere* and *Glenlui* off Prinsep's Ghât. The former has had three of her plates and several of her frames bent and fractured on the starboard side, just below the poop and three more plates forward. She broke her mooring pipe and tore away a part of her bulwarks as well. The best part of her saloon has had to be cut away to let the surveyors form an idea of the damages sustained. The repairs will cost, it is believed, something like Rs. 6,000. The *Glenlui* suffered some slight damages.

Jno. C.

UNFAIR COMPETITION.

Sir,—The following Engineer Officers are posted to the South Indian Railway:—Messrs. W. G. Gilchrist, F. G. Brook-Fox and W. Drew.

The *Pioneer* of 2nd instant has the above information regarding the transfer of the three Engineers named belonging to the D. P. W. to South Indian Railway, and I think a notice in your "Paper" may do good, as the question is being agitated about Government men being lent to Companies.

Mr. W. G. Gilchrist is 2nd grade Executive Engineer.
" F. G. Brook-Fox 3rd " " "
" W. Drew 1st " Assistant "

I also invite your attention to your paper, page 176 of 2nd April, stating that the Supreme Government had sanctioned three additional Assistant Engineers for the same private Railway, and no doubt numerous applications have been sent in by qualified Engineers disengaged, outside the Department;—with what success it is easy to conceive from the nominations mentioned in the opening quotation of this letter.

W. W. S.

Literary Notices.

CALENDAR, 1887. College of Agriculture, Madras.

WE have been favoured with a copy of the prospectus of the Madras College of Agriculture for the current year. The College is situated about 6 miles to the South of Madras near the village of Saidapet, and the attached Map shows the distribution of the College Farm, Botanical Gardens, and College Buildings. The Courses of Instruction are all that appear to us to be necessary for the *practical* agricultural training imparted by the Institution. A distinctive omission in the volume before us is the total absence of the names or composition of the Teaching Staff. An interesting feature, however, is the list of persons holding the Certificates of the College, with their present occupation, and it is satisfactory to find therefrom that the College meets a widespread demand.

PROCEEDINGS OF THE ENGINEERS' CLUB OF PHILADELPHIA.—Vol. VI.—No. 1.

THE opening article of this volume on "Photographic Map Reduction" will be of interest to Engineers, as shewing how large a saving of time and labour may be effected by means of the camera as here described. The author, Mr. O. B. Harden, says :—

It has been frequently necessary to have maps reduced and duplicated in the shortest possible time, in order that the original maps might not be long away from the offices in which they were frequently used. This is especially true of railroad maps. The time necessary to do this became a matter of importance, and as the most accurate, quickest and cheapest means of reduction, they have been reduced by the camera.

The maps have been of a variety of scales, from 100 feet to 1 inch, to 6 miles to 1 inch, and have been reduced as small as 10 miles to 1 inch. It has not been found that the size of the reductions affected in any way their accuracy. It may be remarked that, however small, there is that fidelity in detail that is only equalled by the photographic lens. To those who are accustomed only to the more common methods of reduction and the fallibility of the ordinary draughtsman, this fidelity to detail is gratifying. Even by the use of the pantagraph and rectilinear lines, the reduction may be accurate in length and breadth and yet be perceptibly wrong within a square, dependent upon the care of the draughtsman.

There is practically no limit to the size of map which may be photographed, as it is only exposed to the camera in sections of about five feet square, when the negative required be as large as 21 × 25 inches, this being the largest size taken by Bien & Co.

The maps are reduced to their proper size by the operator tacking a strip of paper with the original scale upon it, above the section of map to be reduced, another strip being cut the reduced size and held up to the ground-glass of the camera until it is so focussed as to be the required scale.

The only element of error entering into the reduction of maps by the camera, aside from the care and skill of the operator, is the expansion and contraction of the sensitive paper. It should, however, come back to its original size after immersion ; if it is found not to do so, an allowance is made by making the scale larger or smaller as the case may require. The accuracy of the reduction depends as much upon the perfect adjustment of the map at right-angles to the line of sight as to the scaling by the operator.

It is unnecessary more than to mention that there is no error due to distortion, this being compensated for by the combined lenses used for such work.

In order to prevent any error resulting from the shrinkage or imperfect joinage of the prints, a templet will be constructed for the final map, with the lines of latitude and longitude on a policonic projection drawn upon them, these lines being on the original map.

A comparison of cost shows that there is a saving of about 40 per cent. over the other methods of reduction. This is where a reduction alone is required and where the map will answer its purpose upon the sensitive paper ; where, however, the map is required upon tracing cloth, or where it has to be transferred to a more substantial paper, the saving is about 30 per cent.

Space precludes us from noticing the other articles. But we may add that they are fully up to the high average of American Professional Papers and of those published in the past "Proceedings" of the Club.

THE GOLD-FIELDS OF VICTORIA.

WE have received the Reports of the Mining Registrars for the quarter ended 31st December 1886, from the Secretary for Mines in the Colony of Victoria.

In addition to the usual statistics which characterise such Official Papers, we find valuable information relative to the average yields from quartz, tailings, mullock, pyrites, wash dirt and cement ; crushing machines, diamond drills, and other mining appliances. The rules regarding the rewards offered for the discovery of new gold-fields might be studied with advantage by the Indian authorities. The regulations for the Examination of Mining Surveyors are instructive as placing an interdict on the practice of *quasi*-professionals.

As regards mining speculation, the "Secretary for Mines" well observes that there can be little doubt that the introduction of outside capital for the development of auriferous resources would be productive of mutual advantage to the investors and the colonists, if the money were judiciously invested in honest, *bonâ fide* ventures ; but when a host of mining companies—some of them of a bogus character—are placed on the market with a rush, at absurdly high figures, it is no wonder that the British public cries out, "Hold ! enough"! He adds that some indiscriminating investors will suffer through the fraudulent representations of a few unprincipled vendors, there is too much reason to fear, while the injury which such proceedings will inflict on this colony—which has so many genuine mining enterprises awaiting development—will be most serious ; for it is certain that one successful attempt at fraud will cause the British public to look with suspicion on every Australian mining venture, no matter how genuine it may be.

It is a singular fact, and one which might fairly tell against Victoria in the London money market, if the circumstances were not explained, namely—that, while we are seeking the introduction of British capital to develop our mineral resources, many of our own miners are deserting our gold-fields for those of Teetulpa, Kimberley, and South Africa. But the explanation is a simple one, and it is to be found in the time-worn adage which asserts that "distant fields *look* greenest." Gold miners, as a class, are of a restless, roving disposition ; and, although their migrations to other gold-fields have frequently, in past times, proved disastrous to themselves, the warnings have been in vain. Several of those who recently rushed off to Teetulpa and Kimberley have returned, disappointed, repeating the experience of their *confrères* at Port Curtis and other places in former years ; and so it will doubtless continue until Victorians awake to the fact that there are at their own doors fields for the profitable employment of labour and capital equal, if not superior, to any on the face of the habitable globe.

JOURNAL OF PROCEEDINGS, ROYAL INSTITUTE OF BRITISH ARCHITECTS. January and March—1887.

WE glean from the January number that the Literature Standing Committee of the Institute agree with the Board of Examiners urging students who wish to pass in Architecture to study Gwilt's Encyclopædia. They declare that there is no other work of the kind published in England that contains such a mass of reliable matter on Arts of Construction. Objection, however, may be taken to the inconvenient bulkiness of the volume and the smallness of the type, but the classification of such a variety of subjects with the necessary subdivisions, arranged in chapters and sections, is so excellent, that the student who opens the book for the first time will experience no difficulty in finding the information he is in search of. The value of the March number is doubtless due to Mr. Josiah Conder's Paper on "Domestic Architecture in Japan." Mr. Conder's experience as Professor of Architecture at the Technical College of Tokyo and also as Architect to the Japanese Government lends weight to his statements and makes them more valuable to the profession. We find two Notes in this same number on "Mud or Earth-Building" by Robert Kerr, and "Mud Building in India" by C. S. Palmer of Indian P. W. D. They add but little information to that which has already appeared in this Journal on the same subject.

General Articles.

BICYCLE AMBULANCE

DESIGNED BY J. E. WHITING, M.A., M. INST. C.E.

ANNEXED is a sketch of an arrangement for an ambulance, which I lately had occasion to design and put together for a sick lady, who was unable to bear the motion of either phætons or *dhoolies* on her way to the hills.

It will be seen that the ambulance consists of the chief parts of two bicycles, from which the trailing wheels and the treadles have been removed. A bamboo is very securely strapped to the trailing or curved bar and lies above the bicycle seats—holes being made in the under surface of the bamboo, so as to admit the projecting pins or pivots* over each wheel. The bamboo then keeps the upper parts of the wheels apart at a suitable distance, to admit a hammock, which is attached to the bamboo by its ropes and has its ends resting on the two seats of the bicycles.

The tails of the bicycles are turned towards each other and two light teakwood rods are attached to the jaws of these tails, one on each side, by the bolts or axles of the (omitted) trailing wheels —these bars keep the lower parts of the structure rigidly apart. Two cross bars are strapped to the handles of the bicycles and pass under the longitudinal bamboo. The cross bar over the rear wheel has two light iron rods with hooks attached to it; these hooks fit into eyes or staples in the longitudinal bamboo, as shewn in the sketch, and so as to keep the rear wheel in plane with the bamboo, the iron frames and the teakwood rods. The front wheel with its cross bar is free to turn about a vertical axis, as usual, in order that the ambulance may take curves and be guided. Four men with a little training run the ambulance easily and safely—they must each hold the central bamboo with one hand and grasp the end of a cross bar with the other—and they can tilt the wheels to one side, when they admit or let out the invalid from the hammock.

Should this form of ambulance prove suitable for hospital or field service, plain stretchers or hammocks with stiffened sides could, of course, be used and could be slung over easier springs than those under bicycle seats; but the wheels can only be used as wheels over smooth ground and should be as small and light as possible; so that the men could lift the ambulance over obstacles and over rough ground, or when they have to turn sharp corners. When tired, the *dhoolie*-men would rest the load on the wheels, and whenever they came to a good track they could go ahead. This bicycle ambulance runs perfectly smoothly on good roads and may be made as light as a *dhoolie*, so as to be carried as a *dhoolie* when necessary.

It is probable that for general use cheaper wheels and frames will be used than those of patent and expensive bicycles.

My objects in requesting you to publish this description are:

1st.—A hope that the plan may be of real service and answer as well in other cases as it did on the road to Mahableshwur.

2ndly.—That your readers may kindly suggest such improvements as they may find by experiment desirable.

J. E. W.

RAILWAYS IN ASIA MINOR.—It is announced from Constantinople that the Turkish Minister of Public Works has presented to the Porte the report of the Technical Commission on the Asia Minor railways. This Commission, it appears, has pronounced in favour of narrow or metre gauge railways. The principal reason upon which it bases its recommendation of this gauge is the economy which is effected thereby in comparison with the cost of construction of normal gauge railways. Another reason which, according to the opinion of the members of the Commission, speaks greatly in favour of adopting the narrow gauge is that the perfection to which science has brought the exploitation of narrow-gauge lines is such that they can be worked with almost equal advantages to those of the normal gauge lines.

* NOTE.—If these do not project they can easily be added.

REPORT ON THE PREVENTION OF THE WASTE OF WATER.

BY S. TOMLINSON, ASSOC. M. INST. C.E., F. R. MET. SOC., DEPUTY EXECUTIVE ENGINEER, WATER WORKS, BOMBAY.

I.

(Continued from page 290.)

15. THE question of having all fittings tested has been frequently before you and the Municipal Commissioner, and, I think, has been practically settled in the affirmative. I would only, therefore, urge that, as early as possible, the necessary instructions should be issued to procure the apparatus and put it in force. It is very desirable everywhere, and a large number of the fittings submitted for test would fail as they fail in those cities at Home where the testing is enforced, yet they might show no failing or flaw which could be detected by the eye.

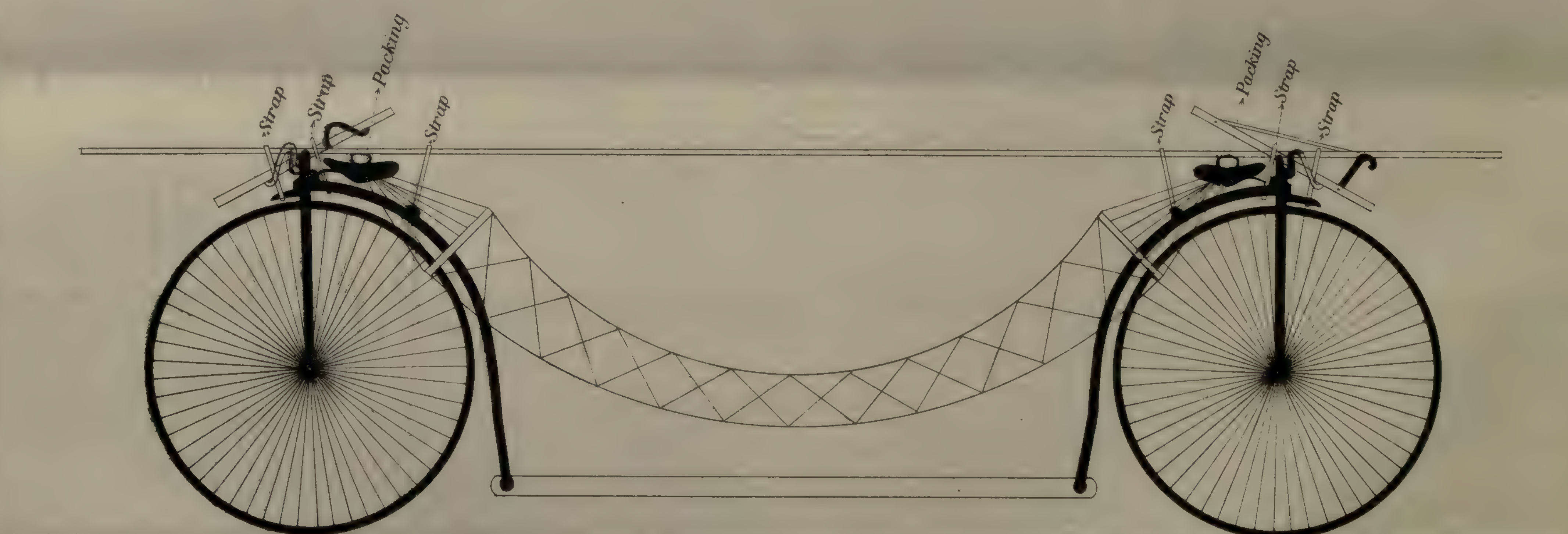
The introduction of the system of testing fittings would, I dare say, be much opposed for a time by plumbers and makers of apparatus, who would find a portion of their goods rejected. It would, on the other hand, lead to a better class of fittings, and a saving to those using them in repairs, and to the Municipality in water.

The first cost of the fittings to owners would probably, for a time at least, be higher, but this would be more than recouped by the saving in repairs and the longer life of the fittings. It should be pointed out that the present cost to owners of repairing fittings must not be taken as a comparison to the coming system, because the inspections will be more systematic and searching, and efficient fittings will be more insisted upon. In this way the cost of repairs to the present class of fittings will be much increased over the present *régime*; it is therefore most desirable, in the interests both of the Municipality and of the owners, that all fittings should be tested and stamped. The cost of testing would be recovered from the parties submitting the articles, who would be required to pay a fee on each article before testing. For the present a fee of 2 annas on each tap or fitting might be levied.

16. I would suggest for your consideration whether the Municipality should not by its own servants undertake all the work of a connection up to and including the stop-cock. This would usually mean the insertion of the ferrule, the laying of the service pipe in the street, and the fixing of the stop-cock. If this were decided in the affirmative, there would arise for decision the question as to whether the Municipality should bear the cost, or recover it from the parties taking the connection.

17. Whatever decisions be arrived at in regard to the above questions, I think it would lead to great saving of water if the Municipality itself repaired leakages to service-pipes in the public streets and to stop-cocks. Much time is now lost in preparing and issuing notices, and in the parties engaging their plumber, and in his attending to the work; and all through these days and sometimes weeks, the waste is going on. In many cases, too, the necessity of repair is disputed, or is attributed to the Municipal servants in some way or other. We must have a system which secures promptitude in the effecting of repairs, if the waste of water is to be effectually stopped. The cost, if the Municipality undertake the work, would not be quite so great as under the present system. All the time occupied in preparing and serving notices would be saved, and the same gang of men could do the repairs in a whole street, instead of, perhaps, as many plumbers as repairs being called in, and all charging for their separate time occupied in passing to and fro. It would involve a heavy charge, no doubt, upon the water-works maintenance, but this could be recovered by a slight increase in the present scale of charges, which are in many cases far too low to pay even the cost-price of the water consumed. The $\frac{1}{8}$th of the total quantity which is supplied by meters provides more than half the revenue. Half of the whole is wasted, and the remaining $\frac{3}{8}$ths are required to supply the remaining half of the revenue. The

SKETCH OF PROPOSED BICYCLE AMBULANCE.



J. E. WHITING.

total charge to owners for water, including repairs, would then not be more than equal to the present charges for water-rate and plumbers' bills.

18. These being the principal matters concerned with the work, it remains to discuss the staff required for it. At present the work is being carried on with a Budget staff of 2 Inspectors and 12 Assistant Inspectors, who are acting under the directions of the Superintendent of Water Works. In connection with the re-organization of your department, I have already submitted to you proposals for transferring this work to the charge of the Chief Turncock and his Assistants. This seems to me necessary for the following considerations. The Ward and Assistant Turncocks are already in part engaged in detecting waste in their own districts and issue the whole of the notices for repairs and renewals. They are responsible for the distribution arrangements, and are familiar with all the details of the arrangement and position of valves, hydrants, the sizes, &c., of the pipes, and the character of the property supplied, the meter supplies, &c. Under the intermittent system a portion of the Assistant Turncock's time is occupied in closing and opening sluices. As soon as the meters are at work, this portion of their duties ceases. They can then be trained, as opportunity offers itself, for the Waste Prevention Work. They are already familiar with their districts, and would soon be able to take up the modified form of their work. Then for purposes of the communication between the Night and Day Inspectors, which is necessary, the Ward Offices would be a natural meeting place. The Ward Turncock or Inspector, as I hope the Municipal Commissioner will approve of their being denominated, would from this office send the nightmen to those portions of his district most needing attention, and the nightmen, returning to the office, would hand over to the daymen the notes of the night-inspection.

It is important, too, that the head-quarters of this work, as a whole, should be at the Municipal Offices, because for some years it will be a work that will require much of my personal attention and care. The Chief Turncock attends office every day, and the Ward Turncocks frequently, so that through them I should be in direct contact with the staff.

It is, moreover, extremely desirable that there should not be two sets of officers, acting from different superiors, engaged on somewhat similar work in the same streets and altering the sluices, &c., without knowing the effect of each other's work.

19. These are the reasons rendering it desirable that the staff should be placed under the Distribution Officers. It is, I think, desirable, too, that the Superintendent, Water Works, should be relieved of this charge in view of the increasing work of the other portions of his Department; the probable addition of a testing department; and I hope the entrusting to him of the custody of the meters issued to consumers,* together with the abolition of private meters. To continue the Waste Prevention Staff under him, with its daily increasing work, would lead to so much delegation of his work that he would not be able to give that attention to the many details which is so desirable.

20. As to the staff required, I think, in view of the extra work of first placing a district under constant supply, the services of the two Inspectors should, for the present, be continued. The number of Sub-Inspectors should be increased to 5 per turncock$=5\times 6\dagger=30$ and 30 coolies. One Assistant should be given me for the office to undertake the tabulating of the diagrams and results, and to assist me in this work especially and in other work if necessary. If this staff were granted, it would be used, for a time at least, where most needed and not handed over to the exclusive use of one ward until that ward were all under constant supply, and they were needed to continue the inspections and maintain the improvement effected.

(*To be continued.*)

* This change took effect in November 1886.

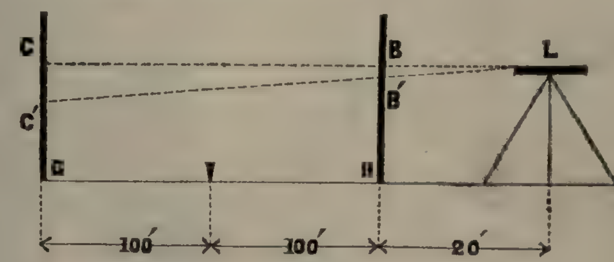
† 7 Inspectors from 1st March 1887.

TO COLLIMATE A DUMPY LEVEL.

MUCH time is usually wasted in moving the diaphragm carrying the cross-hairs too much or too little, and not uncommonly in moving it the wrong way altogether. The following is an improvement on the old method designed to obviate this.

It is based on the fact that if a level is placed at known distances from two staves, the difference between the readings before and after adjustment on one staff is to that on the other staff as the distances of the respective staves from the level.

The figure will make this clear.



L = level 20′ from nearest staff.

B H, C G = staves 200′ apart.

Let C′ B′ be the line of collimation of the level before adjustment.

C B the same after adjustment.

y = C C′, the difference of readings on one staff.

x = B B′ do. do. other staff.

Then by similar triangles—

$$CC' : BB' = CL : BL,$$

$$\text{or } y : x = 11 : 1;$$

$$\therefore y = 11x \quad \ldots \quad \ldots (1.)$$

Now let d = difference between the readings on the two staves before adjustment,

$$\text{or } d = B'H - C'G = CC' - BB' = y - x \quad \ldots \quad \ldots (2.)$$

Combining (1) and (2), we have $x = \frac{d}{10}$ and $y = \frac{11}{10}d$.

These formulæ enable us to bring the line of collimation to the horizontal by one setting of the diaphragm.

Take an example:—Select a fairly level piece of ground and drive four pegs in a straight line at distances of 0, 100, 200, 220 ft. These distances must be exact. Set level over peg at 100 ft. and drive pegs at 0 and 200 till they read the same. Move level to 220 ft. peg and read the two staves. Suppose the distant staff reads ·06 less than the near staff. Then the line of collimation points *down*.

$$d = \cdot 06, \quad x = \frac{d}{10} = \cdot 006, \text{and } y = \frac{11}{10} \times \cdot 066.$$

Now we must increase the reading on the distant staff by exactly ·006 by moving the diaphragm *down*. On reading the near staff, we shall find its reading increased by ·006, and since $\cdot 066 - \cdot 006 = \cdot 06$, the error is corrected and the line of collimation is exactly level.

J. C. M.

HINDOO'S MODE OF REAPING AND CLEANING GRAIN.—The *Milling World* tells its readers how the Hindoo reaps with an iron blade, six inches long, an inch wide, and curved like a sickle, costing him four cents. He squats on his heels, cuts a handful, lays it down, and without rising off his heels waddles forward and cuts another. In twelve days he cuts an acre, and receives five cents a day, boarding himself. When he wants to thrash his grain, he drives a stake in the ground, spreads his grain around it, ties a rope to his bull's horns and then to the stake, and drives them around and around till the straw is tramped very fine into what they call "bhoosa." This is fed to the cattle after the wheat is separated. Englishmen have introduced thrashing machines, but the Hindoos will have none of them. They think their cattle would not eat the straw because it breaks it instead of tramping it flat. They clean their wheat by holding it up in the wind in a scoop made of reeds, or, if the wind is not blowing, two Hindoos make wind by waving a blanket, while a third dribbles the grain from the scoop.

TECHNICAL EDUCATION FOR INDIA.

ONE of the burning questions of the day is, whether there is any immediate need for the development of technical education in India beyond the limits it has already reached. While considering such a subject it must be borne in mind that we are not dealing with a country where the hand of civilization has never been, but rather where it has flourished for centuries, and has resulted in establishing systems and customs suited to the habits of the people and calculated to meet the requirements of their every day life. The introduction of Western civilization into India has doubtless brought in its train much that is foreign to the country, and the question of the further development of Technical Education here is, therefore, intimately associated with the consideration as to how far the people will avail themselves of those systems and modes of life which are different from such as they have adopted and been accustomed to for ages past, and how far it would conduce to their well being if they did so avail themselves. Inseparably connected with these considerations would be the question as to how far such changes here would influence the prosperity of England herself as a large maufacturing and trading centre.

Mr. Francis J. E. Spring in a treatise on the subject of Technical Education for India gives us much valuable information regarding the means adopted in England, America and the continent of Europe for imparting such an education, and then formulates "proposals and suggestions for the establishment in India of a general scheme of technical instruction, after the model of some of those which have been found so successful elsewhere." Without discussing these proposals themselves we would notice in the first instance the grounds on which he bases them. He says in Chapter I. "It cannot fail to strike the thoughtful observer that in a country like India—*possessed* of *magnificent natural resources* in the shape of many descriptions of *raw produce* in practically unlimited quantities; of *the cheapest labour supply of which any country can boast*; and *of manipulative skill of the very highest order*, as is evidenced by the beautiful and artistic productions of her hereditary workmen—it ought to be possible, with proper direction and organization, *to render the* 250 *millions of inhabitants more independent than at present of extraneous assistance for the supply of such of their needs as require industrial skill*; and yet we find an enormous and ever increasing value of raw produce leaving our shores, only to return after a journey of many thousand miles in the form of finished goods, which, with a proper organization of capital and skill, we ought to have been able to manufacture ourselves." Herein lies the root of the whole matter. Mr. Spring could hardly have put his case more forcibly or tersely than he has done in those few lines. If we may be permitted to summarize what is already an epitome, perhaps to the ordinary reader the lines of the argument pursued would be more clear.

He states three facts from which he draws a certain conclusion. India he says, (1) is possessed of "many descriptions of raw produce in practically unlimited quantities," (2) she has "the cheapest labour supply of which any country can boast;" (3) the "artistic productions of her hereditary workmen give evidence of manipulative skill of the very highest order." Therefore, he, concludes "it ought to be possible, with proper direction and organization, to render the 250 millions of inhabitants more independent than at present of extraneous assistance for the supply of such of their needs as require industrial skill." We have no desire to question the *possibility* of such a result; we are rather concerned with its *probability* and its *desirability*. Assuming the data laid down to be correct, does it follow that because a country abounds in raw produce, therefore it should also undertake the manufacture of such materials, instead of exporting them? Here the hand of nature is bountiful, and the sons of the soil instinctively see where their advantage lies. It is their privilege to scatter the plenty of their land to other countries which are less favoured. Agriculture should be, and very properly is, if we may call it, the greatest national occupation of the people in India. That they do utilize some of this raw produce by manufacturing such articles of use among themselves as are necessary, is undeniable, but to organize any general system of technical education which would practically have the effect of changing a large proportion of those agriculturists into handi-craftsmen, or the latter into skilled workmen, would be to subvert the very foundations of Indian society, and would tend to cut off those very supplies of raw produce which now are the chief source of the wealth and prosperity of the country—for this must be the result from a paucity of labourers. Again, would labour continue to be cheap under these altered circumstances? India is said to have "the cheapest labour supply of which any country can boast." But why is it so? Because it can boast chiefly of *unskilled* labour which is performed by people of *simple habits*, having very *few artificial* wants, and who are therefore content with *small wages*. Let the Indian workman be taught to appreciate the benefits of a pot of ale, a good cup of tea or coffee, a substantial flesh diet twice a day, and the use of a little more clothing of a less flimsy character than he uses now, and India will cease at once to be the cheapest labour market in the world. Let the labourer be removed from the simple plough and the loom and be taught all the arts of working mills and manufactories on improved methods as a skilled labourer, he will at once claim higher wages, and with higher wages, must come the adoption of expensive habits and modes of life. That India is willing to accept such a change does not appear. On the other hand, from a quotation made from Dr. Hunter in the pamphlet under review, it is abundantly clear that the current has set entirely in the opposite direction. The passage runs thus—"In 1837 India exported about ten million worth of luxuries......... In 1887 India will export ninety million worth of staples." English capitalists have realized the situation, for this remarkable increase in the exportation of staples represents to a large extent the outcome of our Cotton and Jute mills which have sprung up of late. There is, however, another phase of the question. Suppose the export of raw produce from India is thus diminished by the supply of labourers being cut off on the one hand, and the materials themselves being utilized in the country on the other, what would be the effect, say on England, whose industries depend almost entirely upon importations from other countries, and very largely upon India itself? Surely the depression of trade would be considerable; first from want of material with which to manufacture, and second from a falling off in the demand for the manufactures themselves.

From what has been advanced, it must appear that it would not conduce to the best interests of India to launch forth, at present at least, into any elaborate schemes for the extension of technical education. We use the word '*extension*' advisedly, for there do exist institutions and workshops in various parts of the country which already impart either directly or indirectly so much of technical instruction as is necessary for present requirements, and in this view we are upheld by the opinion of no less an authority than the Rev. Father E. Lafont, who, in his evidence before the Public Service Commission, gave it as his decided opinion that it would be a waste of public money to attempt to carry out any large scheme for the extension of technical education in India. There is, however, in India a supply of labour which might be turned to very good account by a little more fostering. The domiciled European community possess those qualities which have distinguished them as an industrial people in their mother country, and which with a little training would render them here thoroughly efficient and useful as skilled workmen and directors of unskilled labour, while it would make the importation of such men almost altogether unnecessary.

Unskilled, cheap, native labour under European super-

vision is the back-bone of India as a trading country, and the development of its resources mainly consists in producing those raw materials of which there exists such an unlimited supply, and for which there is such a great demand in other markets. It is true a portion of this comes back to India in the shape of manufactured articles, but even granting that these could be manufactured here without diminishing the supply of raw produce by drawing away unskilled labourers, it still remains an open question whether India as a competitor with other advanced manufacturing countries, would stand better commercially, than she does now as a supplier of raw produce.

It is hardly necessary to enter upon a discussion of the specific proposals put forward by Mr. Spring, based as they are on data such as the above, and following as they do systems which prevail elsewhere, but which would in many cases be found impracticable here.

L. W. D'C.

IRRIGATION WORKS IN THE NIZAM'S DOMINIONS.

THE grant in the Public Works Department Budget with regard to Irrigation is not sufficiently large to be effective for new works, improvements, and extensions.

Hitherto the grant for Irrigation has just sufficed for the normal wants of the country, such as the restoration of such tanks as may have breached during the last or previous monsoons, or the repair of important reservoirs that were considered in a dangerous condition, or the construction of feeding channels to supplement the water storage in tanks that were provided with comparatively small catchment basins. The expenditure thus incurred, although in many cases highly remunerative, was to a great extent of a protective nature in order to save the existing revenue. The proposal to increase the present annual allotment of about 17 per cent., by another 14 per cent., will suffice to carry out more of such works as are referred to above, without providing sufficient funds for new and larger projects that would substantially increase the Government revenue. Experience has proved that the country about Hyderabad, from its very rocky and undulating character, is little adapted for canal works, except at a very inordinate cost. Irrigation projects of this kind are best suited to the region of inundation rivers, which afford all the advantages necessary for good alignment, and command sufficient ground on either side for purposes of irrigation. It is needless to say that such advantages do not exist about Hyderabad, although some scheme of canal irrigation might be undertaken in connection with the Godaveri river and its larger tributaries towards Chanda. The extension of the Railway to Chanda will give an impetus to such work, as the country now is overgrown with jungle and little known. The Kistna and its tributary, the Tungabadra, possess in many places advantages for irrigation, and some of their tributaries might also be utilized for this purpose to a greater extent than they are at present. A minor scheme has been worked out from the Manjira river, and will be described later on.

The projects that have just been alluded to, are such as might be carried out in course of time by the ordinary Public Works Department grant, but what is most urgently wanted, is a scheme which should embrace the restoration of all irrigation works in the Telingana, that are likely to return a good revenue to Government. It has been roughly calculated that there are upwards of 18,000 tanks, large and small, distributed over Telingana, a large percentage of which are either in ruins or more or less out of repair. The country also throughout this region is sparsely populated and overgrown with jungle, while many of the villages have been completely deserted by the fever-stricken inhabitants. Consequently, the scheme proposed should be sufficiently comprehensive to include the restoration of the tanks, and concurrently with it, the reclamation of the jungle regions and the re-population of the deserted villages.

The extension of the Railway to Warangal, and the further extension which is in progress towards the East coast on the one side, and the Chanda on the other, together with the formation of a Mineral Company, have brought the question of the reclamation of Telingana into such prominence, that a special committee has been appointed, to consider the best means of improving and restoring the numerous irrigation works that are scattered over this vast tract of country. The committee has not yet submitted its report, but the main lines on which the members have based their views have been ascertained, and are in agreement with the views entertained by the principal officers of the Public Works Department. They comprise the systematic restoration of the various tanks in Telingana, according to the series to which they belong; and for this purpose, every third tank in each series will be made strong enough and with sufficient surplus water-way to carry off the excess water in case the upper tanks become breached. At present the minor works are often inadequately repaired on the sanction of the revenue authorities, and a disaster to any of the upper tanks has often been the signal for the failure of a large number of tanks lower down in the series, and this annual calamity has been a great source of loss of revenue to Government, besides entailing much labor and anxiety on the Public Works Department officials during the most inclement season of the year. The systematic restoration of these tanks under some special agency, will, it is hoped, ameliorate much of this, and be the means of largely improving the existing revenue.

In regard to the funds that will be required for this purpose, it has been proposed to raise a loan which will be repaid from the anticipated increase to the revenue. A special extra establishment will be organized at a cost of about 10 per cent. of the total outlay, which outlay will be exclusively devoted to the work of restoring the tanks systematically, in the series to which they belong. This will not interfere with the normal expenditure for irrigation provided yearly in the Public Works Department Budget, but will come under the head of extraordinary expenditure. The establishment will be attached to the Public Works Department as the "special Irrigation Branch," and its work will be controlled and supervised by the principal Public Works Department officers.

STEEL.

"Iron and all metals are liquids.

"Cold steel is congealed iron, containing in solution various ingredients, which give to it certain marked properties.

"Heat is the power which gives to steel all of its good and all of its bad conditions.

"Steel is as mercurial in structure and volume as mercury is in volume.

"Slow, quiet cooling from a high temperature causes the formation of large, irregular crystals, and renders the steel weak.

"Quick cooling and agitation form small uniform crystals and a strong condition.

"The application of heat alone will change the form and the size of the crystals.

"The change of volume due to a unit of heat increases as the content of carbon increases; therefore high carbon steel must be handled with exceeding care.

"The temperature to which it was last subjected, moderated by its subsequent treatment, is always recorded in the structure of steel, and may be read there if the piece be fractured.

"Annealing, making soft, ductile and uniform in texture, is the most important of all operations from an engineer's point of view.

"Steel being crystalline, has no fiber; therefore there should be no sharp angles, no sharp edges, and no unfilleted corners; the surfaces should be smooth and free from tool marks or indentations caused by sledge blows and the like.

"With our present knowledge, the *best steel* for structural purposes is that which is most nearly composed of iron and carbon.

"Finally, good steel, properly worked, is the most useful of all of man's productions, and it may always be relied upon to do its full work to its utmost limit; but if the laws of its being be violated it will as certainly respond, causing disappointment and disaster."

THE MADRAS HARBOUR.

Its Construction, Destruction and Reconstruction.

X.

Mr. Molesworth's report on the destruction of the harbour comprised recommendations for its reconstruction. He said :—

I agree with Mr. Parkes in the view that separate settlement is desirable, and I think that with unequal settlement bond would probably be destroyed, but in re-construction I should prefer an arrangement which would enable the principle of self-adjustment to go even further than that advocated by Mr. Parkes, by re-constructing the faces and elbows on the lines of the existing structure, but with random blocks on the principle adopted with success in many of the French breakwaters. A vertical wall is probably the best form of breakwater that it is possible to adopt so long as it stands, but when once it begins to fail it will soon be demolished in detail, and the inclined courses render the structure more liable to fail if the portion behind them is carried away. The character of construction I would suggest is roughly indicated in Diagram No. 11.*

The hatched portions shew the probable position of the original blocks in a typical section, whilst the others shew the additional blocks it will be necessary to deposit; the addition that should be made to the rubble base is also shewn; it is probable that some of these blocks will be displaced, and others will have to be added from time to time to make good any breaches that may arise, but in the event of the displacement of any portion the block that is moved is alone affected, and the stability of the whole is not threatend by failure of a part.

Bearing in mind the destructive wave action which I have already described, the random block construction appears to me to possess the following advantages :—

1st.—The direct blow of the wave, instead of being delivered simultaneously on a flat surface, will be delivered in detail on the angular surfaces, and the force will be more broken.

2nd.—The concussive blow will also be more in detail and the blocks better supported.

3rd.—The interstices being large, the air and water will escape more easily, and the compressive action will be lessened.

4th.—Both the drawing action and the vacuum will be less decided.

5th.—The structure would have greater stability as a whole.

6th.—The random blocks, being jammed, one against another, will require more force to displace them, and the blocks have to travel over a very irregular surface.

7th.—The displacement of one block will not affect the remainder, and when displaced the block still performs its work of assisting the others.

8th.—If the section be found too weak, it can be strengthened without change of design.

9th.—All the materials of the existing breakwater are at hand and available without further expense in moving them.

The mode of laying the blocks must be left to detailed consideration after the actual position of the *débris* of the present breakwater has been accurately ascertained. If the vertical wall can be restored by the addition of new blocks, so as to render it available for the distribution of materials, it would probably be the most simple and expeditious plan of distributing materials, but, if not, it will be necessary to have recourse to floating shear legs, such as were used at the breakwater in Alexandria.

Mr. Molesworth admitted that the random block system was by far the more expensive, and advised the retention of the vertical wall system for the sides of the harbour, with gneiss rubble protection from under-scour on the outside, and he did not think that so far much harm had been done by the adoption of Mr. Parkes' method of construction for the seaward parts of the harbour, as the blocks had been conveyed to where they would be ultimately required in the cheapest and most expeditious manner possible. In addition to the re-construction of the sea-faces and elbows on the random block principle, and the protection of the outer feet of the sides with gneiss rubble, Mr. Molesworth recommended the prolongation of the sea-faces northward and southward, tangentially to the elbows in order to neutralise the confluent action of the waves, to which he attributed the scour that undermined the elbows, the space between them and the prolongations of the faces being filled in with rubble sloped outwards from the harbour. Mr. Molesworth also thought that the width of the entrance, being unusually great, ought to be reduced, but that the question did not press for immediate settlement. His estimate of the cost of reconstruction was—

		Rs.
3,100 lineal feet @ Rs. 400	...	12,40,000
Extension of faces and fitting	...	6,00,000
Rubble protection to sides	...	2,00,000
Additional plant ...	...	4,00,000
Contingencies ...	...	1,00,000
Establishment ...	...	1,60,000
Total Rs.	...	27,00,000

* See Diagram No. 3 of our Plate III.—Ed.

making, with money already spent, a total cost of $83\frac{1}{2}$ lakhs of rupees, or, say, £730,000 for 7,836 feet of breakwater or £93 per lineal foot, which was a very cheap rate as compared with that of the largest works elsewhere, £120 to £360 per foot. We have omitted to mention that Mr. Molesworth recommended that the blocks for the outer slopes of the random work should be of 30 or 35 tons weight, instead of 27 tons as before: also that the blocks should not be used within six months after being manufactured, unless a greater proportion of cement were used. The composition of the blocks had been—1 cement, 2 sand, 5 broken-stone, $2\frac{1}{2}$ large stone.

Mr. Parkes submitted his proposals for the reconstruction of the demolished works—remedies, as he called them—on the 9th March 1882, though the nature and extent of the damage had by that time been so imperfectly ascertained, as we showed in our last article.

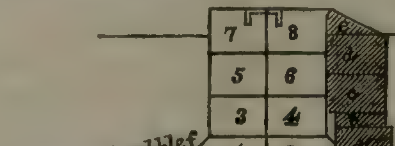
Remedies.—The whole of the actual damage to the works is due to one or other of the above causes, and I think that if the original section were amended so as to give increased strength to the two weak places shewn to exist, every confidence might be placed in its stability under even a much heavier sea than the recent one. The section as carried out was a perfectly good one to withstand a moderate sea, and the effects of the heavier sea show no grounds for any radical alteration. Such material as there was was good in quality and properly disposed, but there was not enough of it; or perhaps it would be more correct to say the principles of the design were good, but not carried far enough. There is not the slightest justification for re-opening the worn-out questions of the relative merits of random and placed blocks, or of bonded and unbonded work. Breakwaters of random blocks, or of bonded masonry, might have stood if very much more massive than those which have partially failed, but their security would have been due to their greater massiveness, not to the different principles of their construction.

Then follows his justification of the use of even soft laterite for the rubble foundation, and of placing the concrete blocks in the work before they had well set, and also his argument that subsidence of the foundation was not only a perfectly harmless process, but even a substantial advantage,—already referred to by us. We will now again allow Mr. Parkes to speak for himself :—

Reconstruction.—In the scheme for reconstruction, then, we have especially to keep in view the two weak points, the foot of the outer wall and the top of the harbour wall. The required object may be attained either by breaking the force of the waves before they reach the weak points or by giving additional strength to the weak points themselves. The former principle has received full consideration. It appeared at first sight that the remains of the original piers would form a good outer barrier under shelter of which a new pier would be safe from damage. But further examination was not favourable to this idea. The shelter it would give in its present state is too irregular. In some parts it might be fairly efficient, but in others it would allow the sea to pass over it on to the new work with increased violence. To prevent this, such places would have to be made up with new material, and this would lead to a serious amount of work, and I think a not very satisfactory result. Besides which there is a considerable proportion of the old work remaining, and the rubble base especially, having been well consolidated, would offer a better foundation than a new one, especially in not being liable to the immediate settlement which caused the fracture of the blocks. Two out of the four courses of blocks are also for the most part in good state, and an uncertain proportion of the displaced blocks may be recovered and used again.

Preference was therefore given to the principle of rebuilding the piers on their original foundations, and making such additions as experience shows to be necessary. The one great objection to this is the immense difficulty of clearing the ground of fallen blocks. The magnitude of this difficulty can hardly be realised without inspection of the ruins. It will undoubtedly be a slow and costly operation, but all who are concerned in it are satisfied of its practicability, and, the difficulty being simply a mechanical one, we may safely conclude that it will diminish with practice and experience.

I propose, therefore, that the work be rebuilt on the former lines and to section, but with the additions shewn shaded on the accompanying sketch, to give increased strength to the two weak points.



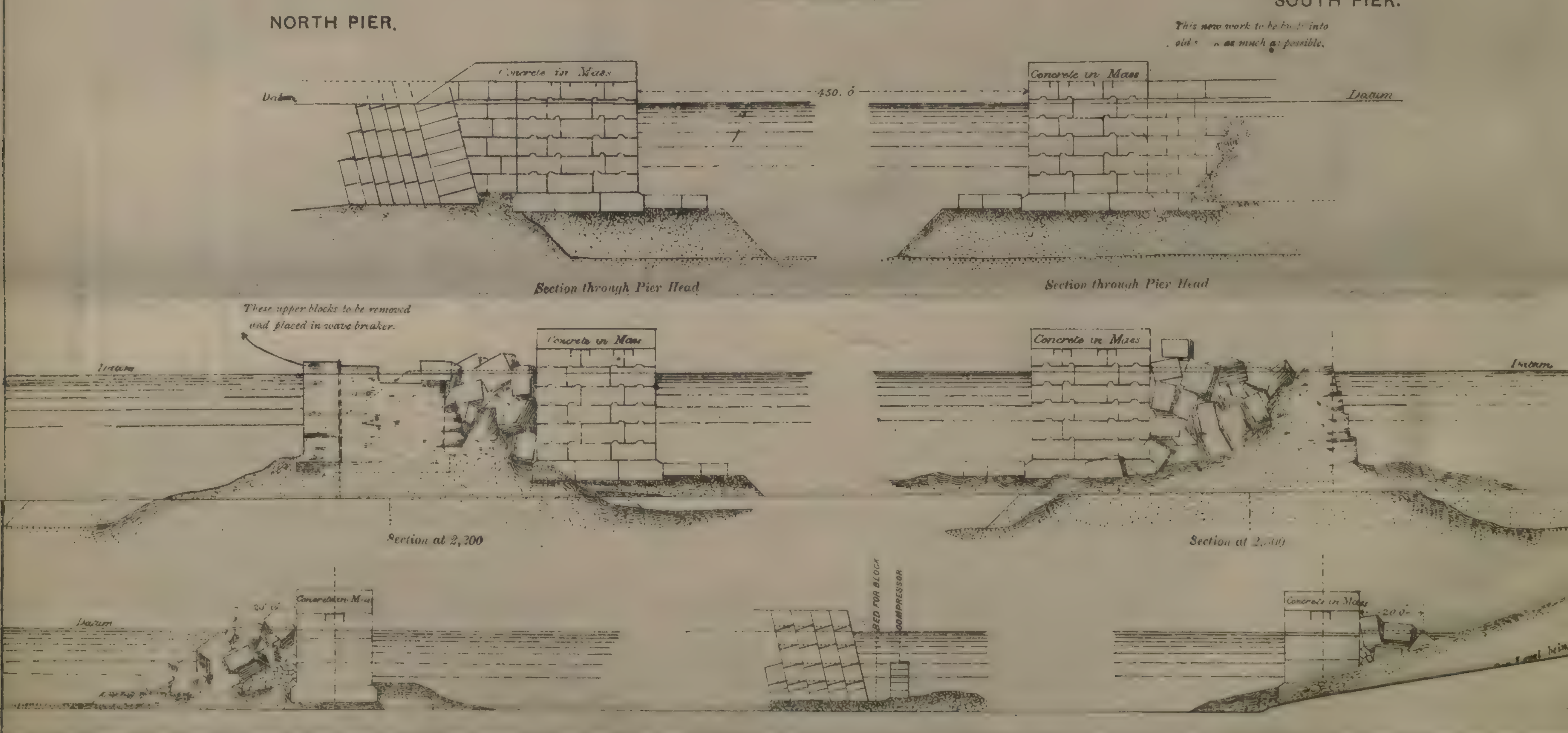
The rubble base and blocks 1, 2, 3, and 4 are generally in a serviceable state; 5, 6, 7, and 8 are new, the former blocks similar to the old ones, except that they will be 9 feet high instead of 8 feet, so as to make up for the 2 feet of subsidence *a*, *c*, and *d* being of the same dimensions as the old blocks, the latter can be used so far as available; *b* is a thin block inserted for the purpose of bringing the top of *d* above water

MADRAS HARBOUR

—SECTIONS OF RESTORATION WORKS—

Described in Mr. Parkes' Report. Dated August 21st, 1884.

SCALE 40 FEET = 1 INCH.



level, so that *e* may be set upon it in a bed of cement, thus making *d* and *e* together into one block of 36 tons weight. The top of *e* is sloped off to give an escape for the falling wave. If it were level like the top of 8, the effect would be simply to transfer the vulnerable point from the top of 8 to the top of *e*, as is shewn by the fact that at the pier heads where the structure was increased to three and four blocks in width the one next the harbour still gave way. Block *f* is intended to protect the toe of the outer wall from scour and ultimate undermining. It should be placed at as low a level as practicable, so as to avoid encroaching on the profile formed by the sea itself.

Besides these actual additions to the section, Mr. Parkes proposed to introduce two extra securities into the top course of the old section. It had always been an object, he said, to connect the top blocks together, both longitudinally and transversely, but it was impossible while settlement was going on. Now, however, in rebuilding on an old foundation it would be easier to do so. He proposed, therefore, so to make the cross joints of the top course that they might be filled with cement, not during the progress of building, but on a suitable opportunity afterwards. How these joints were to be kept clear of sand and marine encrustations, animal and vegetable, or cleared of these when the time for filling the joints with cement arrived, does not appear.

Mr. Parkes also proposed to connect the two top blocks by an iron cramp made of a bent, worn-out rail cemented into them. He said it was impossible to shew the sufficiency of these additions to the work by figures, as the force of the sea was an indeterminable quantity, but he thought it quite outside the limits of reasonable probability that a force of sea would have to be encountered so much greater than that of the late storm, as the strength of the new section would be greater than that of the old. Mr. Parkes did not propose to apply the additions to the section to the uninjured portions of the piers, because they had shown no signs of weakness except some scouring away of the rubble at their bases, and this he would remedy by feeding with heavy granite boulders. But he proposed to tie the top blocks together with iron cramps as elsewhere. And to prevent the blocks of the elbows from opening out like a fan should there be any leaning over to seaward, he proposed to cut a groove longitudinally along the top of the sea wall (*i.e.*, the outer top row of blocks) about 12 inches deep all round the curves, in which a strong chain cable should be laid, strained up tight and then buried in concrete. Mr. Parkes called attention to the fact that each one of the additions he had recommended was intended to meet some weak point disclosed by the action of the sea upon the work, and that he had made no attempt to meet theoretical objections that were not supported by the special experience of the particular occasion.

In endeavouring to estimate the cost of works of restoration, Mr. Parkes found great difficulty owing to uncertainty as to the proportion of blocks that would be found available for future use in the superstructure of the work, but he framed an estimate in two parts, the first for restoring the work to its former state, exclusive of the small portions of the original design that were incomplete, and the second for the additional strengthening works he recommended. The first part he gave in two alternatives, a maximum of a little under 9 lakhs of rupees, and a minimum of a little over 6 lakhs. He assumed that Government would take the maximum estimate as the basis of its deliberations, but he would hope that the minimum would be realised. The second part of the estimate was based on the prices at which the work had hitherto been carried on, and might therefore be taken as reliable. Its total was a little over 9 lakhs. Therefore Mr. Parkes said :—

The total cost of placing the whole work in an efficient state may be taken as lying between the limits of 15½ and 18¼ lakhs, and I think three years will be required from the time of recommencing building operations for its completion.

The second part of the estimate (that for new works) is the amount which would have been added to the original estimate if we had had the data necessary for making provision against the force of a cyclonic sea. The first part is the penalty paid for our ignorance on this point. But I may remark that this is not altogether without its equivalent. If the work had been carried out in the first instance in its stronger form, its completion would have been delayed by two years, and for those two years the harbour would have been in a less efficient state than it is now with the damaged piers.

Present efficiency of the Harbour.—Indeed, the business of the harbour has proceeded with scarcely any change in consequence of the accident, and although steamers have the option of saving the payment of extra dues (levied according to the present admittedly inequitable system of charging on the register tonnage instead of on the cargoes landed and shipped) by anchoring outside, they invariably submit to the grievance and come in. The injury to the harbour is scarcely felt during fine weather, when the great bulk of the landing and shipping operations are carried on. Its evil effects will be felt in moderately rough weather when more sea will come into the harbour, though even then the damaged piers will be better than none.

It seems useless to give the details of Mr. Parkes' reconstruction estimate, as it was altogether set aside, and ultimately he estimated the cost of the work to be done as prescribed by Government, acting on the advice of a Committee of eminent Engineers at home, at Rs. 45,90,051, making, with Rs. 64,85,537 spent before the storm of November 1881, including protective works and compensation, a total cost for the harbour of Rs. 1,10,75,589, against Rs. 58,46,165, the total of the original estimate.

In commenting on Mr. Parkes' proposals for reconstruction, Colonel Sankey, the Chief Engineer of the Madras Public Works Department, said that everything depended upon the force of the sea to be provided against, and that it might fairly be asked whether the storm of the 12th November had supplied a sufficiently crucial test of the forces which might be expected to be called into action in a cyclone of maximum intensity. After pointing out that the disturbance due to the waves must have at Madras reached down to 35 feet below low water at least, and referring to observations made in other parts of the world, Colonel Sankey said :—

It may, in fact, be inferred that we are in the presence of forces which cannot at present be sufficiently gauged, and the reasoning on which the monolithic system of reconstruction rests is incomplete. There is apparently insufficient ground for Mr. Parkes' contention (paragraph 24) that there is not the "slightest justification for re-opening the worn-out question of the relative merits of random and placed blocks, or of bonded and unbonded work."

On the contrary there would seem to be ample grounds for considering the question of adopting or rejecting the monolithic system for Madras as still open. With a bonded wall, such as that proposed, it needs but little imagination to infer what the effect would be of a succession of heavy seas precipitating themselves over the seaward arms, or how the impact communicated to the first attacked blocks would send a vibration and quiver in advance which must go far to loosen and weaken the stability of the mass—every succeeding blow shaking the structure from end to end. Even where the piers had a thickness of four blocks at the ends of the seaward arms, the impact was such as to ruin them quite as easily apparently as where there were only two blocks.

Again, it must be clear that the stability of a structure of this particular form must in great measure depend on whether the foundations are such as can safely withstand the scour which takes place down the face of the wall, or the disturbances due to the general cyclonic action before alluded to, which tend to drag out and flatten the material of the rubble base as during the late storm.

With a structure having its upper portion constructed of random blocks of sufficient size, the action being on the individual block, no general vibration can be communicated to the mass, and the seas must get broken up in a manner which is quite impossible with a structure on the monolithic system ; the work could in fact hardly be destroyed, though individual blocks might be displaced.

The undersigned does not bring forward this as an original suggestion, as he was given to understand by Mr. Molesworth that, although possibly not for precisely the same reasons, the random block system was that which generally recommended itself to him.

The Chief Engineer roughly estimated that the cost of reconstruction on the random system, including an apron of blocks for the uninjured shoreward portions, and extra rubble for base seaward where the damage had been greatest, would not exceed 25 lakhs of rupees. And he thought that blocks of 35 to 40 tons would be needed for the more exposed portions of the work.

(To be continued.)

It is hardly creditable to Sheffield and Birmingham, that, with all their skill and appliances, they are unable to turn out sword blades with anything approaching the fineness of temper and keenness of edge possessed by the swords of Japan. The weapons hitherto supplied to the British Army could hardly pass the tests to which some Japanese swords are said to have been subjected of cleaving a bar of lead in two without indenting the blade, and cutting in halves a leaf, floating on a stream, by merely allowing it to drift against the edge.

CONCRETE.

WITH the splendid material that there is in India for concrete, it is surprising that so little use is made of it. Concrete, as used in foundation work to walls, in floors, or in roofs, is not referred to, but concrete in arches primarily, and in walls secondarily. There is the *khoah* of Bengal, broken brick, that can be broken to any convenient size and of which any brickfield will supply unlimited quantity, whether of good ordinary brick or well burnt *jhamma*, and there is the *Kunkur* material, out of Bengal, from Raneegunge to beyond Agra and Delhi.

Concrete in walling undoubtedly requires a special plant and entails some considerable amount of care and difficulty in arranging for and carrying out economically, but as used in arches there is not the faintest excuse for its non-use: it is as easily and conveniently laid in place as the *khoah* of ordinary terracing, and must of necessity cost less than brick arching. The cost of centering is the same in both cases, but the material and the labour are far less in concrete than in brickwork.

Concrete should be used, as it is largely in France, in the bridges for feeder roads, where often the concrete arch could be built on a sand or *muttee bund* for a centering. It could be built in far less time, and with little more than coolie labour, than a brick arched bridge.

The only instance in Calcutta of any extensive use of concrete arching to roofs and floors is in the office building of the East Indian Railway, where all of the out-office roofs, the floors and roofs of all the corridors and of the large inner compartments are of concrete. The circles vary in span from 3ft. 4in. up to 4ft. 6in. and in continuous lengths of one span of 23ft. The rise of the arches varies from 3in. up to 5, and in thickness the crown of the arches is often only 2½in. In the roof of the out-offices they undulate on the upper surface, that is, the haunches are not fitted in level. Economising material, where a level roof or floor is unnecessary, each hollow or undulation offers a good water channel or valley for the escape of water.

The proportions of the material used is—of small broken *khoah* (such as would pass a 1¼in. ring) 5, soorkee 1, kutni lime 1, and Portland cement ½ or $\frac{1}{16}$th the whole. This is a very small proportion, but quite sufficient, with good cement, as was proved from the fact that the centre could be removed in 24 hours after it had been laid in place. All the proportions were carefully measured in a box, and the cement only added when the last mixing took place.

Another example of the use of concrete to arch construction in Calcutta is in a bridge of 25ft. clear span over a jheel. This bridge was built on a *muttee bund*; it is 38ft. over all of the abutments, 9ft. wide at the ends and 5ft. wide in the centre, with a rise of 3ft. 9in.—the thickness of the arch at the centre being only 8 inches and at the haunches about 3ft. The road way of the bridge rises 1ft. 6in. to the crown from the abutments. The abutments are of ordinary foundation concrete, with no cement. The arch itself is of *khoah* 5, lime 1, soorkee 1½, cement 1; and in the arch-work, the concrete of which was laid in 2in. layers, are embedded three tiers of hoop-iron, 6 rows in each width. The centering was moved within a week of completion, and the arch when struck by a hammer or a brick rings like a bell.

As to cost, concrete in arches can be done at the rate of Rs. 16 per hundred superficial feet, which will well bear comparison with ordinary terraced roof and floors; it is homogeneous and practically indestructible and admittedly fireproof.

Such a thing as a concrete-built wall does not, I suppose, exist in India. *Kunkur* would make magnificent arch work used in concrete—the very nodular character of its formation being in favour of its forming good bond with the molar matrix of lime, soorkee or sand, and cement. Bearing in mind the miles of concrete walls in dock work in Europe or the bridges of concrete in France, it is surprising that of the many Engineers of the Public Works Department none have made use of it as a material of construction.

B.

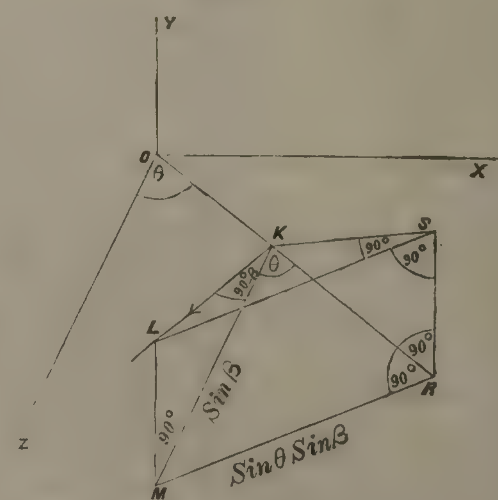
[The Editor of this Journal contributed a "Note" on *Concrete Culverts* to the Roorkee Professional Papers in July 1884—*vide* No. 6, Vol. II. (Third Series).]

THE GEOMETRY OF THE OBLIQUE ARCH.

BY A. EWBANK.

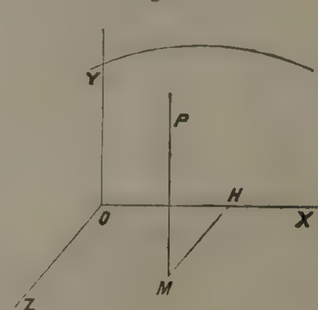
IV.

Fig. 4.



THE position of any point in space may as in Descriptive Geometry be determined by reference to three planes such as those in *fig.* 4. It is true that in Descriptive Geometry two planes only are mentioned. One, the plane Z O X, is called the horizontal plane. The other, Y O X, is called the vertical plane. But the existence of a third plane Y O Z, is tacitly assumed; for otherwise two distinct lines, each paralled to O Z and in the plane Z O X would be undistinguishable. If we are allowed to measure from a fixed point O in the "ground line" O X this amounts to postulating the existence of a third plane normal to each of the other two and passing through O.

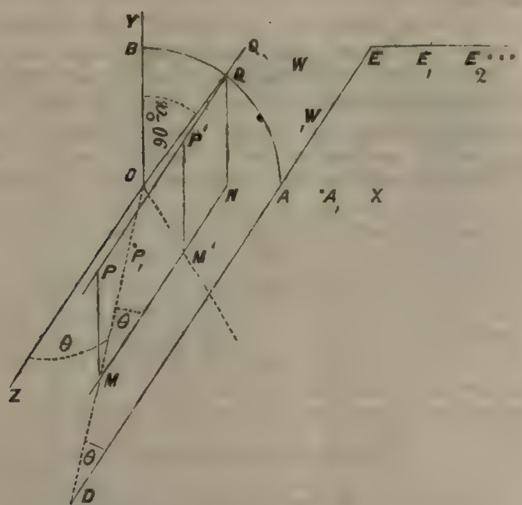
Fig. 10.



Let a point P anywhere in space be defined by its distance x from the plane Y O Z, its distance y from plane Z O X and its distance z from the plane X O Y. This arrangement is illustrated by *fig.* 10 where from P we draw P M normal to the plane Z O X, and then draw M H parallel to Z O to meet O X. Then O H$=x$, H M$=z$, M P$=y$. Such a point may be called the point $x\,y\,z$.

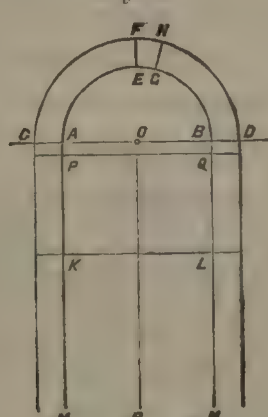
In *fig.* 11 A Q B is a part of a transverse section of the inner cylinder, Q is any point in the circle A B. Parallel to the axis O Y the line Q N is drawn. P is any point in a spiral which we suppose to start from A. If P be always on the same spiral we require a constant ratio between the straight line P Q and the curved line or arc Q A. Let P Q$=m$ Q A. Then if m be zero the spiral reduces to the circle A B. If $m=1$ we have a spiral whose pitch is 45°. In any case let β be the pitch, then $m=\tan\beta$. The pitch being given the position of P depends only on the angle A O Q. This angle is called a. Therefore the $x\,y\,z$, of P should be expressible in terms of a, m, and the radius r of the cylinder.

Fig. 11.



In fact $x = \text{O N} = r \text{ Cos } a$; $y = \text{Q N} = r \text{ Sin } a$; $z = \text{Q P} = m \text{ Q A} = m\, r\, a$, where a is the angle expressed in circular measure. These equations, in which a is a variable angle, give the various points of one and the same spiral. In our oblique arch the angle a changes gradually from zero to π. Now suppose the circle A B to increase its radius from O A to O A^1, produce O Q to O Q^1 where O Q_1 = O A^1. Draw P P^1 equal and parallel to Q Q^1. Then A^1 P^1 is a spiral on another cylinder having a larger radius but a length (measured parallel to O z) unchanged. This new spiral makes a complete turn in the same length as does the spiral A P. If A A_1 = the line E F of *fig.* 1, then the spiral A_1 P^1 is the outer edge of that male screw which we described as having a finite height E F and no thickness.

Fig. 1.



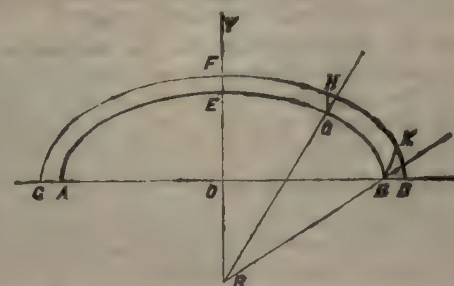
If the length A A_1 is very small—say the length of one of our blocks of stone, which we may imagine as small as we please,—then we may have a number of small and equal increments A A_1, A_1 A_2, A_2 A_3, ...A_{n-1} A_n where A A_n = E F of *fig.* 1. Then we get a corresponding number of spirals A P, A_1 P_1, A_2 P_2, ... A_n P_n. These being superimposed successively, each on the one immediately preceding, generate that male screw, which in the oblique arch corresponds to the coursing *plane* in the common arch.

For a point P in the first or lowest of the spiral lines we have $x = r \text{ Cos } a$; $y = r \text{ Sin } a$, $z = m\, r\, a$.

For a point P_1 in the lowest spiral but one we have $x_1 = r_1 \text{ Cos } a_1$; $y_1 = r_1 \text{ Sin } a_1$; $z_1 = m_1\, r_1\, a_1$, where a_1 is a variable angle on the change in which depends the position of $x_1\, y_1\, z_1$. If in the second spiral we take P_1 obtained from P as above then $a_1 = a$. But if P of the first spiral lies in the vertical plane y O m, that is in a face of the oblique arch, then this P_1 will not lie in this plane face. For Q_1 Q cuts the plane at O and therefore P P_1 which is parallel to Q Q_1 will also cut and if produced will pass through the plane.

If a is less than a right angle the figure allows us to conclude that we must produce the spiral A_1 P_1 to obtain its intersection with the vertical oblique arch face. To this point we will return to clear up any difficulty that may remain. Meanwhile let the point of intersection so found be called S_1. Similarly the spiral A_2 P_2 will need to be produced, that is continued, to some point S_2. Then the intersection of the arch face with the thin male screw surface is the line (straight or curved) which passes through P S_1 S_2 S_3 ... S_n. One of these lines is the curve G H of *fig.* 9.

Fig. 9.

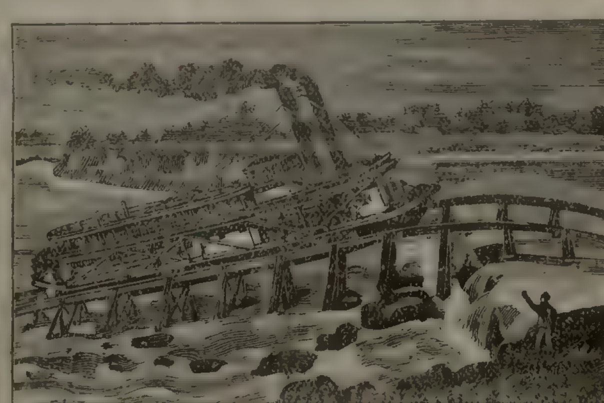


(*To be continued.*)

CROSSING THE RAPIDS.

[Translated from *Le Monde de la Science et de l'Industrie*, for INDIAN ENGINEERING.]

IT is well known that the navigation of streams and water-courses, brought to such perfection in America, is often greatly impeded in some places by the existence of falls or rapids, which cannot always be encircled by canals with locks. American invention, always fertile, has been for some time busy with the problem of effectually overcoming these untoward obstacles, and Mr. Grondahl, of Portland (Oregon), has, in order to accomplish this, proposed the arrangement represented in our engraving. A system of rails, supported by strong timber-work, is erected over the rocks forming the rapid, and joins by as gentle a slope as possible the bed of the lower level to that of the higher.



Steamers navigating the river would be provided fore and aft with small lateral wheels, placed at the height of their bows and arranged in such a manner as to catch well on the rails. The wheels at the back, furnished with the same axles as the large paddle wheels used throughout the United States, act as propellers and enable the steamer to advance on the iron declivity as easily as a locomotive. Should the steamer be a tug, or used for the purpose of towing, all the boats are similarly provided with wheels, and we can imagine the curious sight that would be offered to lovers of the picturesque by the passage of such an aquatic train.

Solid iron fittings would preserve the lateral wheels from shocks when the boats are at mooring against the quays.

The inventor proposes, moreover, that there should always be a steam engine kept in the neighbourhood of the rapids, in order, in the absence of a tug, to tow over the boats by means of a cable, and, in case of need, to assist steamers over the incline.

Mr. Grondahl's idea is undoubtedly an ingenious one; but is it practical? This is another question, and we would wager a good deal against the likelihood of a steamer railway, such as we have just described, ever existing any where but on paper. A.

NOTES FROM HOME.

(From our own Correspondent.)

A Bill on the subject of Private Bill legislation has been introduced proposing to transfer the consideration of private bills from Select Committees to 3 "Parliamentary Commissioners" to be appointed by Her Majesty. Of these each Commissioner selected to hear a bill is to have all the powers, jurisdiction and authority now possessed by Select Committees for the purpose of hearing the case for and against any private bill and for dealing with its preamble and clauses, Parliament, however, retains its control over these bills and the powers sought appertain only to England.

A Conference called together at the suggestion of the Association of Municipal Engineers, and consisting of delegates from the various technical societies which are brought under the operation by the Sanitary Registration of Buildings Bill has commenced its sittings. The first of these was taken up in appointing the officers of the Conference and in generally admitting that registration of Public Buildings would be desirable. The promoters thus obtain the confirmation of the spirit of this bill—the discussion on the bill itself will be taken clause by clause at the next meeting of the conference.

A Paper was lately read before the Society of Civil and Mechanical Engineers by Mr. R. E. Middleton on The Forth Bridge. The paper dealt exclusively with the foundations, giving interesting details of the sinking the caissons and the methods used in overcoming difficulties in the exceptional cases occurring here. The hydraulic spades were described which were used to pierce the tough clay which forms the bed of the structure. And the methods adopted to rescue and restore the wrecked caisson, a costly accident that caused considerable delay to the works. The paper is to be followed by a second from the same author on a future occasion describing the superstructure.

By the last quarterly report on these works by General Hutchinson it appears that up to date 409,200 cubic feet of masonry have been set and about 1,02.000 cubic yards of concrete work been built, and the average number of men employed during the past quarter has been 2,960. The works are making considerable progress, and it may not be uninteresting to mention that the bridge can now be seen from the Calton Hill, Edinburgh.

Notice is given that the President of the Institution of Civil Engineers will hold his conversazione at the South Kensington Museum on the 25th of May.

By the Registrar General's recently published annual summary of births, deaths, &c., for last year it appears that the general death rate for the year for the whole country was 19·27 per 1,000 of the population. The actual mortality ranged from 17·1 in Brighton to 28·9 in Preston (Lancashire.)

"*Engineering*" gives an illustrated account of the Leviathan Floating Crane which was constructed last year for the Tilbury Docks. This is the largest lifting apparatus of the kind yet constructed. It will lift weights up to 50 tons at a radial distance of 52 feet and will swing the load through a complete circle without altering the position or trim of the hull. The height from the water line to the jib head is 96 feet, thus enabling the crane to ship and unship masts in the largest steamers that trade to London.

The second torpedo boat built for the Italian Government by Messrs. Yarrow has, at her trial trip, exceeded the performances of her predecessors. The trial took place yesterday and a mean speed of 25·10 knots or 29 miles an hour was attained :—with the tide she is said to have travelled at the rate of 31 miles an hour.

Mr. J Bailey Denton and Coll. Jones, V. C. have for some time been pressing on the attention of the Home Secretary and the Metropolitan Board a plan which they have devised for conveying the whole of the Metropolitan sewage to Cauvey Island, a low lying tract on the Essex shore between Thames Haven and Southend. Mr. Denton has recently delivered a lecture before the Parkes' Museum on "Metropolitan Sewage disposal." This together with the papers recently read before the Institution of Civil Engineers, form a means of judging of the merits of the rival plans. Mr. Denton estimates the entire cost of the Cauvey Island Scheme at £198,000 per annum including interest on capital. It will be remembered against that, that the cost of the Boards scheme is £118.000. On this score alone it may be argued that while there is any chance of anything being done at Crossness and Barking, it seems unlikely that anything will come at present of the Cauvey Island Scheme.

A description is given in "*Invention*" of an automatic tipping bucket for loading and discharging ships' cargoes by Messrs. Dowell and Co of Glasgow. In the old fashioned way where a bucket is attached to a crane, a man has to be employed to knock the clutch out so that the bucket may swing round and empty itself. In this machine which seems a useful labour saving appliance, the engineman in charge of the steam crane need only heave to or drop the weight on the lever when the pressure from the same will unloose the clutch and cause the bucket to turn over, immediately after which it resumes its position and is ready to be lowered again. In addition to the saving of labour, a speedy discharge of cargo is claimed for this invention, as well as the avoidance of accident as no one need be near while the bucket is emptying itself.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Bombay, May 12, 1887.

Khan Saheb P. H. Patuck, Assistant Engineer, 1st grade, is appointed to act as Executive Engineer, Ahmednagar, during the absence of Mr. J. C. Pottinger, on privilege leave.

The following promotions, being in excess of the scale authorised for the existing strength of the establishment of Executive and Assistant Engineers, are cancelled :—

Mr. E. K. Reinold to permanent 2nd grade Executive Engineer.

Mr. J. G. Single to sub. *pro tem.* 2nd grade Executive Engineer.

Mr. S. Rebsch to permanent 3rd grade Executive Engineer.

Captain E. C. Spilsbury to permanent third grade Executive Engineer.

Mr. C. N. Clifton to sub. *pro tem.* 3rd grade Executive Engineer.

Rao Bahadur G. R. Tillak to permanent 4th grade Executive Engineer.

Khan Bahadur F. C. Tarapoorvalla to permanent 4th grade Executive Engineer.

Mr. W. L. S. L. Cameron to sub. *pro tem.* 4th grade Executive Engineer.

Mr. E. F. Dawson to sub. *pro tem.*, 4th grade Executive Engineer.

Rai Saheb Butnath Chakrabati to permanent 1st grade Assistant Engineer.

Rao Saheb P. K. Chitale to permanent 1st grade Assistant Engineer

Madras, May 10, 1887.

The following promotions are made :—

Honorary Lieutenant and Deputy Assistant Commissary D. Falvey, Assistant Engineer (Supernumerary), 2nd grade, to be Executive Engineer, 4th grade, officiating, with effect from the 5th April 1887.

Mr. G. F. Handcock, Assistant Engineer, 1st grade to be Executive Engineer, 4th grade, temporary rank, with effect from the 24th April 1887.

Mysore, May 7, 1887.

Mr. E. R. Subrayer, Executive Engineer, Hassan Division, is granted privilege leave for two months from the 2nd instant, or date of departure.

Mr. C. B. Halagaiya Gauda, Apprentice Engineer, attached to the Tumkur Division, is granted privilege leave for one month, with effect from the 1st proximo, or date of departure.

India, May 14, 1887.

Colonel C. H. Luard, R.E., Chief Engineer, 2nd class, Consulting Engineer to the Government of India for Guaranteed Railways, Calcutta, is granted special leave for six months, with effect from the 15th May 1887, or such subsequent date as he may avail himself of it.

Mr. E. H. Hallum, Executive Engineer, 3rd grade, State Railways, whose services have been lent to the Southern Mahratta Railway Company, is granted furlough for twenty months in India. This cancels Public Works Department Notification, dated 22nd April 1887.

Mr. F. L. O'Callaghan, Superintending Engineer, 1st class, is appointed Engineer-in-Chief of the Sind-Pishin Section of the North-Western Railway, *vice* Brigadier-General J. Browne, C.B., C.S.I., R.E., from the date on which the latter avails himself of the leave granted in Military Department Notification, dated 6th May 1887. This charge will include the main line from Sibi to Killa Abdulla, with the Gulistan Branch, and the Bostan-Quetta portion of the Quetta loop. It will also include the Kwaja-Amran Railway Survey, of which Mr. O'Callaghan is now in charge.

Military Works Department.

The following appointment is made, with effect from the 1st May 1887:—

Major W. Peacocke, R.E., to be an Executive Engineer, 3rd grade, supernumerary.

Director-General of Railways.

The Honorable E. H. S. Napier, Assistant Engineer, 2nd grade, passed the colloquial examination in Hindustani, as prescribed in Public Works Department Code.

With reference to Public Works Department Notification, dated 28th April, 1887, Babu Bhupat Rai, Apprentice Engineer, is posted to the Bellary-Kistna State Railway.

Baboo Boroda Prosad Bosu, Executive Engineer, 4th grade, sub. *pro tem.*, having joined the Sind-Pishin State Railway, Northern Section, to which Railway he was posted in Director-General's Notification, dated 29th June 1886, Director-General's Notifications dated 13th April 1887, posting him to the Bellary-Kistna State Railway, is hereby cancelled.

N.-W. P. And Oudh, May 14, 1887.

Buildings and Roads Branch.

With reference to Government of India, Public Works Department, Notification, dated the 28th April 1887, posting him to these Provinces, Babu Chandu Lal, Apprentice Engineer, is appointed to the 3rd Circle, Provincial Works.

With reference to Government of India, Public Works Department, Notification, dated 7th May, 1887, appointing Colonel F. D. M. Brown, V. C., to officiate as Superintending Engineer during the absence on privilege leave of Colonel E. Swetenham, or until further orders, Mr. J. W. Alexander, Executive Engineer, 1st grade, is appointed to officiate as Superintendent of Works, *vice* Colonel Brown, and is posted to the 3rd Circle, Provincial Works.

Mr. F. S. A. Orchard, Executive Engineer, Agra Division, is transferred to the charge of the Rohilkhand Division, Provincial Works, *vice* Mr. J. W. Alexander.

Mr. C. J. Sheridan, Executive Engineer, 2nd grade, attached to the Meerut Division, is transferred to the charge of the Agra Division, Provincial Works, *vice* Mr. F. S. A. Orchard.

Irrigation Branch.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following promotion with effect from the date specified:—

Mr. M. Nethersole, from Assistant Engineer, 1st grade, to Executive Engineer, 4th grade, temporary, *vice* Mr. N. F. McLeod, on furlough, 17th April 1887.

Central Provinces, May 14, 1887.

Mr. J. B. Chirnside, Assistant Engineer, attached to the Wardha Coal State Railway, returned from the privilege leave granted to him in Public Works Department Notification, dated 4th February 1887, and resumed charge of his duties on the afternoon of the 27th ultimo.

Furlough to Europe for 18 months is granted to Mr. P. P. Rogers, Assistant Engineer, 1st grade, and Deputy Manager, Wardha Coal State Railway, with effect from the 20th April 1887.

Mr. J. B. Chirnside, Assistant Engineer, is appointed to officiate as Deputy Manager, Wardha Coal State Railway and Warora Colliery, during the absence on leave of Mr. P. P. Rogers, or until further orders.

With reference to Notification, dated 7th instant, Mr. P. P. Rogers, Deputy Manager, surrendered, and Mr. J. B. Chirnside, Assistant Engineer, assumed, charge of the Wardha Coal State Railway and Warora Colliery, on the afternoon of the 28th ultimo.

Bengal, May 18, 1887.

Mr. F. Sills, Executive Engineer, 2nd grade, was, on return from furlough, attached to the office of the Superintending Engineer, Eastern Circle, with effect from the 14th December 1886.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department:—

189 of '86.—August Schausten, Engineer, residing at No. 1733, New Jersey Avenue, North-West, in the City of Washington, District of Columbia, and United States of America.—*For improvements in means for propelling canal boats.*

215 of '86.—John A. McRae, of Montreal, Canada.—*For a machine for crimping leather uppers for boots and shoes.*

16 of '87.—Henry Hamilton Remfry, of 5, Fancy Lane, Calcutta, Solicitor and Patent Agent.—*For an improved apparatus and till for indicating and automatically registering the several amounts of money received.*

48 of '87.—Joshua B. Barnes, Engineer, of Springfield, in the State of Illinois, United States of America.—*For improvements in furnaces for locomotive engine boilers.*

74 of '87.—Ewald Fischer and Max William Weber, both of Schlegelstrasse, 10, Berlin, in the German Empire, Engineers.—*For improvements in extracting gold and other precious metals from their ores and apparatus therefor.*

76 of '87.—Alfred Nobel, of 53, Avenue Malakoff, Paris, in the Republic of France, Engineer.—*For improvements in explosives and in the use of explosives especially in shells and torpedoes.*

Notices.

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Owing to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Obituary.

Keelan.—At Mussoorie, on the 11th May, Mr. Henry Keelan, of "Erin House," Dehra Doon, Deputy Superintendent, Great Trigonometrical Survey of India (retired), in his 70th year.

INDIAN ENGINEERING.

SATURDAY, MAY 28, 1887.

THE *ENGLISHMAN* AGAIN !

In our issue of the 14th instant we found cause to comment on certain statements made in the *Englishman* of the 9th May, regarding the manner in which the higher appointments in the Public Works Department were distributed in the service. Our remarks were to some extent anticipated by a correspondent who subscribed himself "Civis" in the columns of our contemporary and who pointed out that—" the complaints of the Civil Engineers were by no means ill-founded,..............and that justice was not being measured out to them as it should be"—giving instances in support of this assertion.

The *Englishman* replies to this correspondent in its issue of Monday the 23rd instant, but the long delay which has occurred between "Civis's" letter and the reply raises a suspicion in our mind that our contemporary has had to resort to Simla for inspiration in this instance. This may or may not be the case, but at any rate we have no hesitation in saying that the reply could not possibly have been more unfortunate. In the first place, it is utterly opposed to facts, and we will deal with some of the statements made hereafter; but, at the outset, we wish to make it quite clear to our readers, that we have always endeavoured to do justice to both sides in this controversy, and that when Royal Engineer appointments have been just and proper, we have always approved of the same. For instance, we have cordially supported the promotions of Colonels Pemberton and Conway Gordon, and as regards other names mentioned in the article under discussion, we have not a word to say. Colonel Wallace and Major Boughey are quite rightly promoted, as belonging to the Revenue, as opposed to the Engineering side of the Railway Branch. Having elected Revenue, they have only been promoted in their turn. Colonel Firebrace is entirely the best man for his present appointment ; and although the promotion is rapid, it is thoroughly deserved, as he is quite the best man in India available for the post, except perhaps two who are already provided for.

But when the *Englishman* comes to facts, it is simply deplorable to observe how they are either wilfully perverted, or absolutely incorrect. As an instance of the former mode of dealing with them, take the following Says the *Englishman :*

" In the first case, that of Colonel Steel, R. E., who was lately posted as Chief Engineer in the Panjab, that officer, it is insinuated has superseded Mr. Mallet. A reference to the last published classified list of the Public Works Department will show that, although Colonel Steel is somewhat junior in grade to Mr. Mallet, he has five years' more service in the Department, and is the senior in age. Moreover, Colonel Steel has *a long experience of Secretariat work,* (the Italics are ours) a qualification which could not have failed to influence his selection for the important post he now holds."

After reading the above we took the trouble of referring to some old classified lists, and were, to say the least, surprised to find that in October 1868 Captain Steel was a 4th Grade Executive Engineer

of 6 months' standing, and that Mr. Mallet came out in the same year as a Railway specialist, and in November 1868 was graded as a *1st Grade Executive Engineer*; so that when Captain Steel and Mr. Mallet had a fair start together, the latter was no less than three grades senior to the former. This superiority Mr. Mallet has retained up to the present day, as he is now 10 places senior to Colonel Steel on the list of Superintending Engineers. And yet the *Englishman* has the assurance to justify his supersession!

Here is an instance of the "absolutely incorrect" fact: The *Englishman* says:—"Major Marshall's *long Secretariat experience*, no doubt, obtained him his appointment in Rajputana, where for sometime past it has been customary to post a comparatively junior Superintending Engineer."

Again we took the trouble to go through the classified list from 1865 to 1886, and we find that (with the exception of two years) the Superintending Engineer in charge of Rajputana has always been either a 1st or 2nd Grade Superintending Engineer. Here is the history of the province: 1865-66 Major Pollard 2nd Class; 1866-67, Major Cadell 2nd Class; 1867-68, Colonel J. H. Forlong 2nd Class; 1872-74, Mr. A. G. Crommelin 2nd Class; 1874-79, Mr. A. G. Crommelin 1st Class; 1879-80, Colonel Steel 2nd Class; 1880-82, Colonel Steel 3rd Class (reverted); 1882-85, Colonel Steel 2nd Class; 1885-86, Colonel Steel 1st Class; when he was followed by Major Marshall a temporary 3rd Class Supg.-Engineer on the 31st December 1886, the date on which the last classified list was published.

As regards the *Englishman's* remarks on the appointments of Major Gracey and Lieutenant-Colonel Cumming we have nothing to say, as our contemporary bases their justice on the ground that they are *military* men. This is truly unanswerable: but we wish to point out, that Civil Engineers have had nearly all the hard knocks, and *lower* appointments, in the Burma and frontier lines, (*e.g.* the Bolan, Sind-Saugor, and latterly the Sind Pishin Railways), in spite of the fact that the Military Engineer receives Military pay proper, which we suppose is for Military risks. When however a case of a *higher* appointment occurs "it is clearly advisable to appoint Military Engineers," according to the *Englishman*.

Our readers will also have noticed the reference to the Secretariat experience of Colonel Steel and Major Marshall as being a reason for their having been posted to their present positions; but we cannot help drawing attention to the fact that so long as the Secretariat is practically monopolised by the Royal Engineers, the Civilians have not a fair chance in this respect.

As we said at the outset, we wish to be as impartial as possible on this question, and repeat that we have always approved of such R. E. promotions as we have considered fair and just to the Department at large; but we again point out to the C. E. Branch that some of the appointments recently made, must result in their being permanently superseded by the Military element for the next ten years to come, unless they realise the importance of, and resist to the uttermost, what is now going on before their eyes. With the exception of the *Indian Daily News* there is no paper, except our own, to plead their cause, and the prejudiced statements of the *Englishman* must be our excuse for again coming forward to discuss a subject which was almost threshed out, and which might be forgotten even now, if the powers that be could only be induced to act with rigid impartiality for the future.

THE JEYPORE GAS WORKS.

The Native State of Jeypore in Rajputana is well known as one of the foremost in India in all matters relating to the material welfare of its subjects. It boasts of many institutions of a scientific and economic nature, and among these must be numbered the Gas Works, for which the people are indebted to the enlightened and forward policy of the late Maharaja Sewai Ram Singh Bahadur. And it is a satisfaction to notice that his successor, the present Maharaja, emulates his illustrious predecessor in this respect. The administration of a Native State must indeed be conducted upon enlightened principles, when we are given an annual report such as that of the Gas Works, which is now before us for the year ending December 31st 1886.

It must be over ten years now since these Works were completed, and the first gas jet lighted in the city of the *Kachwahas*, (the name of the clan of Rajputs from which the reigning Chiefs of Jeypore originally sprung), and many changes and improvements have doubtless taken place since then. Before, however, we proceed to review the report, we propose taking a brief retrospective view of the Gas Works. It was, if we remember rightly, some time in 1875 that a foreigner by the name of Silbiger went to Jeypore with the object of exhibiting his method of generating gas, and persuaded the then Maharaja to light his capital and palace with it. There was great opposition on the part of certain State officials to the proposed innovation, and many and powerful were the arguments used to dissuade the Maharaja from entrusting such an important measure to a "foreign adventurer"; even the British Resident, we are told, set his face against it. But Ram Singh was a man of firm purpose; and having made up his mind to it, he carried out his idea and Jeypore got its Gas Works. Every one predicted a signal failure except the Maharaja, and when in 1876 he opened the Works in the presence of a large gathering of his fiefs and nobles and the European residents of the place, there was an expression of triumph on his features, and all present were fain to acknowledge that he was right after all. This in brief is the history of the Jeypore Gas Works, which has since its establishment considerably extended the sphere of its operations, as the report before us bears ample testimony. The present Superintendent, Mr. S. J. Tellery, was the Engineer in charge of the Works from their commencement; and when they were completed, and the Durbar took them over from Silbiger, Mr. Tellery was put in full charge, and there he has remained ever since.

The gas-generating apparatus is of the type usually found in Germany, and the material used for generating the gas is oil. At first only castor-oil was used, but now we see that kerosine and "gas-oil" are employed. The financial working of this department is not as satisfac-

tory as it might be, for we note that the total expenditure during the past year amounted to Rs. 63,750. But of this nearly Rs. 20,000 were spent upon original and special works, mainly in lighting the Albert Hall, the foundation stone of which was laid by H. R. H. the Prince of Wales in February 1876, and which is situated in the beautiful "Ram Newas" Gardens. There were also other minor works, such as lighting the Meteorological Observatory, the Raj Council Chamber, the Protestant Church, and other places. Still the revenue compares very unfavourably with the expenditure, having amounted to only Rs. 5,618, derived chiefly from the sale of a few by-products, such as gas-tar, coke, &c., and a small sum from the supply of gas to private individuals. There is little doubt that the revenue from this latter source is capable of being considerably enhanced if the suggestion made by the Superintendent is adopted by the Durbar. It appears that the townspeople, especially merchants and shop-keepers in the main streets, object to the charge for the laying of the gas-pipes to their residences; but if this could be done at the expense of the *Raj* they would consume gas largely. The Superintendent is of opinion that this can be done without loss to the State, and will ultimately result in advantage to the Works and profit to the *Raj*. The latter has not as yet been able to see its way to adopting this suggestion, but we trust will do so and soon. The quantity of gas generated during the year was 2,466,990 cubic feet, or 30,000 less than the outturn of the previous year. This falling off, as well as the increase in cost of production, amounting to about 0-3-6 per 1,000 cubic feet, is ascribed by the Superintendent to his also having charge of the State Garnet Works, whereby he is unable to give his undivided attention to Gas Works.

It appears to be quite clear that the Jeypore Gas Works have a reputation for efficiency outside the State, for we are told that, at the request of the Executive Engineer in charge of the "Viceregal Lodge," the Durbar sent Mr. Tellery up last year to Simla to inspect and set right the gas works at the Viceroy's residence. Mr. Tellery found the apparatus in use there to be of an obsolete kind, which only generated gas of an inferior and smoky description. Mr. Tellery, however, entirely altered the machine for less than half the cost at which it was originally erected, so that now the Viceroy and his staff have a capital supply of gas. We hope that Mr. Tellery's services, and the readiness with which the Durbar complied with the Simla Executive Engineer's request, have been suitably acknowledged.

THE MADRAS HARBOUR.

THE Secretary of State, yielding to representations from Madras, has allowed the question of the proper position for the entrance to the Madras Harbour to be re-opened, and has accordingly referred it to a Committee of experts at home. And at the instance of the Harbour Board, the Madras Government has sent home its Master Attendant to represent their views, and asked the Secretary of State to stay proceedings pending Captain Taylor's arrival. As readers of INDIAN ENGINEERING know, the single entrance facing about east by south, provided by Mr. Parkes, the Chief Engineer of the Harbour Works, has always been protested against by both the Madras nautical authorities and most of the captains of ships frequenting the Port, and it is alleged that when the Harbour was completed, as it virtually was before its destruction in November 1881, smooth water inside was not provided. From whatever direction the wind blows the waves approach the shore in a line nearly parallel with it, and therefore have free access into the Harbour the mouth of which points perpendicularly from the shore. And it is not believed at Madras that reducing the width of the entrance from 550 to 450 feet, as was to be done in the reconstruction of the Harbour, would materially improve matters. It will be recollected that Mr. Robertson, the expert first consulted, before Mr. Parkes interfered, agreed with the first Madras Committee, that an isolated breakwater was the only work from which any real good was to be hoped, and that his reasons were—(1) that for an equal sum of money a breakwater would give much more *deep* water shelter than a harbour; (2) that it would create a considerable length of sufficiently smooth water at the coast line to enable boats to land or to come to jetties; and that vessels could enter and quit more easily from behind a breakwater than through the one entrance of a harbour. Mr. Robertson also said that a closed harbour would probably require a breakwater in addition to keep out the swell. In the article (No. V.) published in INDIAN ENGINEERING of 2nd April last, it was shewn that a breakwater parallel to the shore of 6,000 feet in length, as was proposed by the Madras Committee and Mr. Robertson, would give a protected anchorage for ships of 258 acres, whereas Mr. Parkes' closed harbour gave a semi-protected area of only 172 acres. The gradually flattening slope of the rubble breakwater would effectually break the waves, and give the smooth water under its lea, whereas Mr. Parkes' perpendicular walls had no such effect, and standing only 6 feet 4 inches above low-water mark they allowed, according to Mr. Parkes' own account, 20 feet of solid water to roll over them. Where the shelter from either wind or sea comes in does not appear. The walls of the Harbour are being reconstructed and raised to 12 feet above low-water mark and are to have a sloping wave-breaker of random block-work; they will, therefore, break the waves, and prevent the enclosed water being much disturbed from spill over the arms of the Harbour; but the rollers would have free ingress, by the eastward mouth. If this mouth be closed up, as the Madras people wish, and the entrance be placed in the north-east elbow of the Harbour, and be protected and slightly overlapped by a straight prolongation of the north-eastern sea-face of the Harbour as wished by the second Madras Committee and Molesworth (see our articles yet to be published), there will be a reasonable probability of smooth water in the Harbour, but the area for ships will still be only 172 acres instead of the 258 which the isolated breakwater of 6,000 feet in length would have given at about the same cost.

Notes and Comments.

THE GEOLOGICAL SURVEY.—Mr. Medlicott's retirement gives one permanent step throughout the Department, and Mr. Hughes' deputation to Hyderabad, Deccan, gives all those below him temporary promotion.

KURRACHEE MUNICIPAL LOAN.—The tenders of the Bank of Bombay have been accepted for the whole of the Municipal loan, amounting to three lakhs, at six per cent. per annum. Tenders from other quarters at rates varying from 95 to 100¼ were numerous, and the total amount tendered was thirteen lakhs, more than four times what was asked for.

BENGAL-NAGPUR RAILWAY.—We learn that Mr. Graves (not Groves as we stated in our last) with his two Assistants—Messrs. Brooks and Anderson—are now engaged surveying between Barakar and Asansol, with a view to definitely decide the point of junction with the E. I. R. Many are in favor of Asansol, which we consider preferable to Sitarampur.

THE HONG-KONG MOUNTAIN RAILWAY.—A Correspondent informs us that the wire tram line to the top of the Peak will not be available for traffic before July next. The haulage engines have been erected and permanent way laid, but many details will have to be attended to and trials made before the line can be pronounced "safe" to the public.

THE PRESIDENCY INSPECTOR OF BOILERS.—We are at a loss to undertand the inaction of the authorities in filling this important appointment which has been for a long time vacant. Rumour will have it that the original idea of appointing a fully qualified expert to the post has been abandoned in favor of a "*Consulting* Inspector," but we can hardly believe that the authorities would adopt such an unwise and objectionable course.

PROGRESS IN HONG-KONG.—The Government of Hong-Kong invite tenders for a Hong-Kong Government Four per Cent. loan for £200,000. The proceeds of the loan will be expended in the completion of the fortifications required for the defence of Hong-Kong as a coaling station, of the extension of the water-works, and other public works, upon the construction of which during the last four years the accumulated surplus balances of previous years have been expended.

MEERUT RAILWAY EXTENSION.—The Branch Goods Line from the Meerut city station of the N.-W. Railway, to the Municipal Bonded Warehouse formerly called Ganga Ram's Mandi, but now Kaisarganj (in honour of the Jubilee year) was opened for traffic on the 17th May. The main object of the line is to afford facilities to the export trade, in which Meerut does a specially large business. It has taken five years to get the scheme carried through. Much credit is due to Mr. Mackinnon, the District Engineer, for getting the line ready ere harvest.

BENGAL-NAGPUR RAILWAY ENGINEERING STAFF.—The following are the names of the Engineers brought out by Mr. Wynne for this Railway :—Mr. Wilde is appointed to take inventory of Chhatisgarh Railway. Messrs. Fairwell and Jennings to straighten out some curves on the same Railway. Mr. Leake for the Nagpur end of the Line. Mr. H. Graves for the Sitarampur end. These five are District Engineers. The Assistant Engineers are :—Mr. Leake, Jr., Mr. Cummin, and Mr. Partridge, all at Nagpur end of the Line, and Messrs O. G. Brooks and F. Anderson, Assistant Engineers, on the Sitarampur end.

RAINFALL REGISTER.—Mr. George Anderson, M.I. C.E., District Board Engineer of Malabar, has pointed out in his report on the Irrity river that the rainfall registers as generally kept are very misleading. Thus, if the 24-hour period is reckoned from noon to noon, a rainfall of 1 inch an hour, which began at 9 A.M., and lasted till 3 P.M., would, if no other rain fell, be recorded as 3 inches on one day and 3 inches on the next, whereas a fall of 6 inches took place in 6 hours. It would add greatly to the value of rainfall observations if at times of abnormal downpours additional measurements of the quantities collected in the gauges were taken at the beginning and end of specially heavy falls, so that results corresponding more closely to the actual conditions of the case might be obtained.

CEYLON RAILWAYS.—The latest rumor is that the Uva Railway Extension Company is being pushed at home, and that the Colonial Government have offered to guarantee the line. It is not known how much truth there is about this report, but unless Government were willing to aid a company by concessions of some sort with regard to the running of the new traffic over the old line, a company could never be formed. A company would never pay on the mere profits on a short line between Badulla and Nanuoya. It is contended that it would not be fair for the Government to get the increased traffic for nothing, and unless an understanding were come to as to sharing profits in the new traffic, as would be done between private companies at home, the chances of a company would be hopeless.

R. E.'s AND C. E's.—A scribbler in a Madras paper asks which of these two classes of Engineers is expected to perform military duties? He always thought the R. E. officer was specially set apart for this special work, and how came it, when an Engineer officer was required to proceed to Mandalay to carry out an irrigation project in connection with military affairs there, how came it, he asks, that a C. E. officer, Mr. Walsh, was called upon in the first instance to go and not a R. E. officer? Mr. Walsh refused to go, and then the hat was sent round a-begging. R. E. after R. E. refused to go, though *they should have been ordered* to go, and at last Mr. Grant undertook the work. Now there is something rotten here too. *Ask* a *military* officer to perform *military* duties! He should have been *ordered*.

PROGRESS IN JAPAN.—The long-talked of Engineering Association of Japan *(Nippon Doboku Kaisha)* appears to have become a reality. We read that it has been started with a capital of two million dollars. Its object is to contract for all works connected with architecture, irrigation, road-making, railways, and so forth. It is, in fact, a big firm of contractors, and, as such, will supply a need greatly felt in the country. Under the feudal *régime*, all works of importance were performed either by officially forced labour or by voluntary combinations on the part of agriculturists. The natural consequence is that there was never developed a class of men corresponding to the large European or American contractors, who can estimate the cost of a big job, forecast the means required to carry it out, and undertake it under solid guarantees for its honest accomplishment.

FEEDER LINES IN WESTERN INDIA.—The necessity of feeder lines in Western India is constantly being pressed upon the notice of Government and of investors, and the rapid subscription of the capital for a small tramway line from Nassick Road on the G. I. P., to

Nassick City, is a proof that the public have faith in the remunerativeness of such undertakings when entered upon in the right localities and with due regard to commercial conditions. Lines which would not repay the bare interest if laid down upon the more elaborate scale may be made remunerative if the cost of land and of stations can be saved—as it can in the case of many a desirable feeder line project; and the prospects of the line being a commercial success are immensely enhanced, wherever it can be laid upon the existing roads.

SUGAR-REFINING BY ELECTRICITY.—The process is an electro-chemical one which is worked by a machine, automatic in its action to a very great extent. Boiling and animal charcoal are entirely dispensed with. No syrups nor soft sugars of different grades are produced, the entire product being hard sugars in whatever forms of sizes which may be desirable to produce, that is, from finest powdered up to and including cut and pressed loaf. One valuable feature in this mode of manufacture is, that all the saccharine matter in raw sugar, whether crystallisable or uncrystallisable, under the old system of boiling and filtering, is by this system rendered into hard sugar, with a small fraction of a loss,—less than one per cent. of the whole quantity. The cost of refining by this process is *2s. 4d.* per ton *2d.* (per cwt.), and the time occupied not more than four hours.

INDIAN TRADE STATISTICS.—The accounts of the trade and navigation of British India for the financial year 1886-87, as compared with those of the previous year, shew the value of merchandise imported was Rs. 61,81,19,608 as against Rs. 55,65,58,655, and that of merchandise exported Rs. 88,48,10,354 as against Rs. 83,88,12,637. The value of treasure imported was Rs. 11,04,83,224 as against Rs. 15,47,78,008, and of treasure exported Rs. 1,72,04,261 as against Rs. 1,10,82,376. The gross amount of import duty collected, including the salt duty, was Rs. 2,49,42,786 as against Rs. 2,25,61,994, and of export duty collected Rs. 70,84,224 as against Rs. 74,38,495. The only items in the list of imports which shew any decrease were metals, railway plant, rolling stock, raw materials, and unmanufactured articles, while in the exports the decrease was confined to live animals, hardware and cutlery, apparel, and "other manufactured articles." The net result was an increase of Rs. 6,88,45,352 in the value of imports and Rs. 4,18,39,530 in that of exports.

THE VICEROY'S MESSAGE ON THE VICTORIA BRIDGE.—The following telegram from the Viceroy was received by Mr. Lyall, Lieutenant-Governor of the Punjab, and made known to those present at the opening ceremonial:—"It is with utmost satisfaction that I find myself called upon for the second time within one month to congratulate you on the accomplishment of railway transit over one of the great rivers of the Punjab. The Jhelum Bridge at Chak Nizam establishes continuous communication by the aid of the Sind-Sagar State Railway between the northern posts of the Province, the trans-Indus Military Stations, Dera Ismail and Dera Ghazi Khan and Multan. The Bridge has been ably located and most rapidly constructed, and I desire that you will convey my satisfaction at the successful completion of their labors to the staff of all grades who have been directly engaged upon so important a work; and especially to Messrs. O'Callaghan, Upcott and Ramsay, who have successively held the post of Engineer-in-Chief of the Line and Director of operations."

THE GUICKWAR'S PALACES.—We glean that the new palace that is being erected for the Guickwar of Baroda, which will cost over twenty lakhs of rupees, and which will probably be completed in two years' time, is a very magnificent building. It is 450 feet long by from 140 to 280 feet broad in various parts. It is in the Indo-Saracenic style of architecture, and is replete with every grace of outline on the exterior, and intricacy of stone and wood work in the interior. The designer was the late Major Mant who, it is stated, committed suicide, owing to his plans being severely criticised after the foundations had been laid and the walls raised eight feet from the ground. Mr. R. F. Chisholm, late Consulting Architect to the Madras Government, has, since Major Mant's death, had charge of the work. It has over a hundred rooms and is divided into two portions, the larger for the Guickwar, and the smaller for the Ranee, which latter is separated from the former by screens of beautifully executed tracery in stone. A lofty and graceful tower, 200 feet high, rises from about the centre of the building.

REMUNERATIVE ROAD IMPROVEMENT.—By the adoption of the plan of city reconstruction, which enabled Baron Haussman to rebuild Paris, and replace the fetid courts and alleys of the old city by broad boulevards and spacious squares, Bombay has obtained one of the finest roads free of cost to the city. The transaction leaves a surplus for adjacent street improvements, and marks the triumph of sound principles over the opposition persistently offered by inexperience and misapprehension. The new highway would have been a very costly operation, if the Municipality had contented themselves with simply purchasing the land necessary for the roadway, and having made the macadamised thoroughfare, presented as a free gift to the adjacent landowners the new frontages, created at the expense of the rate-payers as a body. By purchasing not only the land of the roadway, but sufficient land on both sides on which to construct the houses constituting the street to be called into existence, the profits of the undertaking fully sufficed to pay for the making of the road, and, as we have seen, it has actually yielded a surplus.

THE FUEL OF THE FUTURE.—Judging from present appearances petroleum is rapidly coming to the front as a fuel. America which has so long commanded the market for that oil in this part of the world, will soon have to contend with a formidable rival, namely, Russia. A trial consignment of Russian petroleum is said to be already on its way to Java. The use of petroleum as an illuminant is rapidly increasing all over the world, while at home and in America experiments have been made with it as fuel for the furnaces of steam engines and for other purposes. When the world's resources in this respect are once definitely ascertained and found adequate to meet reasonable demands, there is no doubt of the great future awaiting petroleum. At present the main obstacle barring the more extensive use of petroleum as fuel for steamers, is its tendency to wear out the boilers too soon. No doubt when inventive minds once set to work to solve this question, some way will be found to remove the difficulty. In the meanwhile it is satisfactory to know that the Director of the Geological Survey thinks he can prophesy safely that the "oil measures of Eastern India will be supplying half the world with light within a measurable time when the American oil-fields have been dry." The sooner English merchants realise this, the better.

Current News.

It has been settled to push the Khwajak-Amran Railway across the Khojak.

At a recent meeting of the Lahore Municipal Committee, Rai Bahadur Kanhya Lal, M.I.C.E., was elected Vice-President of the Municipality.

The capital of the Cawnpore Cotton Mills Company is to be increased from 5 to 10 lakhs, by the issue of a further 5,000 shares of Rs. 100 each.

It is said to have been decided that the railway bridge over the Ganges at Benares shall be formally opened by the Viceroy on the 2nd of November next.

We learn that Mr. A. D. Rollo, Assistant Secretary to the Agent, B. B. & C. I. Railway, has been appointed Chief Storekeeper of the Bengal-Nagpur Railway.

Major A. W. Baird, R.E., Deputy Superintendent, Survey of India, is appointed to officiate temporarily as Assistant Surveyor-General, *vice* Lieutenant-Colonel R. Beavan, S.C.

We learn that Messrs. Arbuthnot and Co., the enterprising Bankers and Agents at Madras, are making enquiries in view to the erection, at no distant date, of a Paper Mill at that station.

Coal in Kubo.—A specimen of coal found common in the Kubo Valley, which was sent to the Geological Survey Department for report, has been declared to be a light coal, and as likely to make excellent fuel for steamer or railway.

The services of Major R. A. Sargeaunt, R.E., Superior Revenue Establishment of State Railways, are, on his return from furlough, placed at the disposal of the Government of Bengal for employment as Manager of the Eastern Bengal State Railway, *vice* Major G. F. O. Boughey, R.E., on furlough.

Mr. John Eliot has taken over charge of the Meteorological Department from Mr. Blandford, who has gone home on eight months' furlough. The Government of India is to be congratulated on again securing the services of an officer of such high abilities as the chief of one of its most important scientific departments.

The Government of India are prepared to carry out the recommendations of the Finance Committee in respect of the charges in connection with the Nilgiri Railway in the event of the railway being finally arranged for *viz.*, that any payment that may hereafter have to be made on account of the Nilgiri Railway should be met by a special addition to the Provincial allotment.

The Lieutenant-Governor has sanctioned the construction of the Calcutta Swimming Bath, on the site selected near Chandpal-ghât. Messrs. Mackintosh, Burn and Co., the well-known builders and contractors of the city, have been entrusted with the erection of the building, and will at once commence work. The Bath is to measure 100 × 34 feet, and is to be fitted with every convenience.

Owing to the services of Messrs. Stoney and Wilkieson, Engineers, Madras Railway Company, being taken up for the reconstruction of the Chittravutty bridge and the Palaghat extension, sanction has been accorded to a temporary addition to the engineering staff of that Company, of two 4th class Assistant Engineers on Rs. 326 per mensem each, with a travelling allowance of Rs. 75.

The opening out of more of the Southern Mahratta Company's line has given a considerable impetus to labor,—a consummation devoutly wished for, for several months past, by some scores of contractors and sub-contractors, and hundreds of the humbler class of workmen. The construction of the line will doubtless be now rigorously proceeded with, to the present and future benefit of the Mysore Province.

The streets of Baroda are now greatly obstructed by wells, but when the Ajiva water-works scheme is completed these will be removed, and all parts of the town will be supplied through pipes with numerous taps in the streets. The palace, too, will probably be supplied direct from the main. The source of the water is the Ajiva Lake, thirteen miles from Baroda, and it is expected that the supply will be unfailing.

The Engineer Officers employed in preparing estimates (1) for doubling certain sections of the Rajputana-Malwa Railway and (2) for converting them to broad-gauge, have now been at work for some time, and their report may be expected in the course of next month. Until these alternative estimates are submitted nothing can be said as to the action which the Government of India are likely to take in conjunction with the Bombay, Baroda and Central India Railway Company, to whom the working of the Rajputana-Malwa system has been leased.

The results of the irrigation in Sind, during the current year, are expected to be exceptionally favorable. The Lahore paper writes :—"The history of irrigation in Sind during last year, as during previous years, has been a history of good work perseveringly carried out ; and all who know how he has worked to improve the efficiency of the Irrigation Department will endorse the regret expressed by the Government of India and the Commissioner of Sind, in reviewing the Report for 1885-86, that Colonel Le-Mesurier's term of office should have been coming to an end.

The Nagpur and Chattisgarh State narrow-gauge railway from the terminus of the Great Indian Peninsula Railway to Raj-Nandgaon, a distance of 146 miles, with a branch three miles in length from Dawhali to Tumkar, was officially handed over by Government to the newly-formed Bengal-Nagpur Railway Company on the 9th instant, from which date that Company undertook the working of the line as part of their system, which is to extend from Nagpur to Sitarampur, a station on the East Indian Line, forming a direct route to Calcutta through the Central Provinces.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

DESIDERATA.

Sir,—It is talked about that the Jabbalpur Water-works project is a most thoroughly worked out scheme as regards both theory and the practical execution of it. As your correspondent "S. P. Q. R.," in your issue of April 30, observes the Government seems inclined to prevent the publication of an existing interesting account of it for the use of its D. P. W members scattered throughout its realms, is it in your power to make your precious Journal yet more so by publishing in its columns such an account of this project as may be existing or may be forthcoming as to interest your many professional readers ?

Secondly.—Any hints or statistics about the rainfall in India, and the proportion which runs off under various conditions of climate, soil, and inclination of country, and the laws which govern absorption and evaporation, will be most welcome

Thirdly.—A practical and popular, at the same time scientific treatment of how strains act in the different kinds of lattice girders, will be a boon to the profession, and, not to say much, your Journal will thus be simply invaluable.

Maisur ; *May* 15. Amateur.

WATER-SUPPLY AND PREVENTION OF WASTE OF WATER IN BOMBAY.

Sir,—The subject of water-supply is one of perennial interest and the reports you are publishing by the District Executive Engineer of the Bombay Works will, I think, be interesting to many Engineers engaged in water-supply work outside Bombay. In Bombay these reports are receiving much attention, and the proposal to charge extra for garden consumption is creating much opposition, but I am more interested in examining the reports as being the first in Indian experience, which deal with the prevention and waste from mains and fittings on the system adopted in many of the larger cities at home. I refer to the use of Deacon's differentiating meters and the practise of night inspections in connection with their use. The reports describe how this system is worked and reveal some of the results obtained. It seems probable, that Bombay will almost repeat the experience of Liverpool, where a 93 hours' intermittent supply was changed into a constant one and at the same time used less water. From the results obtained I am not surprised that the energetic Municipal Commissioner of Bombay, Mr. E. C. K. Ollivant, should urge upon the Vice-Chairman and Corporation the necessity of strengthening the staff so as to extend the system to the whole of Bombay ; at present about ⅙th of the population is under constant supply.

I feel convinced in perusing these reports that the Bombay Municipality will find the prevention of waste to be a most valuable aid in assisting them to meet the demands for water-supply on account not only of rapidly increasing domestic wants, but also for the shipping and trade purposes.

The proposals made by the Municipal Commissioner and recommended by the Executive Engineer, Mr. Rienzi Walton, M. Inst. C.E., whose long experience in Bombay gives his recommendation great weight, embrace also the enforcing of a thorough test for all fittings used in connection with water works and the work of laying power service pipes in the streets to be done by the Secretary as being more likely to result in efficient and economical work. A new form of stopcock suitable to the case and the climate and a dial plate for the Deacon's meter are also being adopted with success.

I refer your readers to the reports you have printed for the details of the results obtained, and feel sure, that a perusal of them will be suggestive to many other Water Works Engineers in India, and I believe they will be a means of keeping water-supply practice in India ahead of the times.

Bombay. C. E.

Literary Notices.

THE RAILROAD AND ENGINEERING JOURNAL. New York: April 1887.

No. 4 of this new periodical—in which, as we have already intimated, the *American Railroad Journal* and *Van Nostrand's Engineering Magazine* have been consolidated—maintains the standard of the previous issues. It is well printed, carefully edited, and full of useful information. These facts bespeak success.

THE DEPARTMENT OF AGRICULTURE AND COMMERCE, N.-W. P. AND OUDH.

WE have received the Report of the Operations of the Agricultural Department of the united Provinces for the year ending 30th September 1886.

The record for the year shews continuous progress in all branches of the Department, and the Government acknowledge that this is due to Mr. Smeaton's active and judicious administration, in which his efforts were efficiently seconded by Colonel Pitcher, the Deputy Director, and Mir Mahomed, the Assistant Director.

We glean that among protective measures, the experiment of cultivating some parts and grazing the remainder of the *usar* land near Cawnpore, promises some measure of success. At Etawah the Collector was able to raise fodder grass in protected ravine land, an experiment which does not, however, throw much light on the possibility of reclaiming *usar*. Measures taken by the Department during the year, with funds contributed by the local Government and the Government of India, have secured a considerable extension to the employment of the apparatus for making trial borings for wells, and efforts have been made to popularize improved dredgers. Wells play an important, and, in some parts of the country, an indispensable part in the protection of the people from famine, and any effort that can successfully facilitate or encourage their construction are of public interest. The net expenditure on arboriculture has been reduced, by judicious measures, for the enhancement of the receipts from lopping and felling, to less than a quarter of the annual grant which used to be made by Government on this account; while the gross expenditure has nearly doubled, and the operations have been very considerably extended. In the Meerut Division, the receipts were more than double the expenditure, and it is probable that arboriculture may, before long, be made entirely self-supporting.

TRANSACTIONS OF THE NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS. April 1887.

THIS number has only three Papers—on "Hydraulic Drills," a "Fire-damp Indicator," and "Securite." Neither of the first two articles calls for notice, and the subject of the last has been already referred to in our "Notes and Comments." The Abstracts of Foreign Papers are, however, better than usual. From them we obtain the following reliable item regarding the Geology of Eastern Tonquin:—

In the delta of the Song-Cau, west of Haiphong, is the so-called Elephant Mountain, consisting of huge blocks of sandstone and a mass of black carboniferous limestone (fossil bearing), with thin intercalated siliceous beds. Opposite this mountain, east of Haiphong, there is another *massif* of limestone and the coal-field is found on the shores of the bay of Hone-Gay. The characteristic rocks are, besides the limestone, quartzite with iron and antimony ores, and shales with numerous casts of plants. These shales generally split the coal seam in two—the double seam (without the shale) being, on the whole, about 3½ yards thick. At the island of Hone-Gay it is 8 or 8½ yards thick. The coal is very shiny, it disintegrates easily, and appears to be of rather mediocre quality. It resembles somewhat anthracite; and marine engineers state that it is of no use as fuel unless it be mixed with an equal quantity of bituminous coal. Workings have been begun in an experimental way, but up to the last advices no other quality of coal had been found.

The subjoined account of the Diamond-bearing Pegmatite of the Madras Presidency is likewise derived from a French Source:—

The chief rocks of the diamond region (Wudjar Curroor, Goondacul, Bellary) are: 1*st*, a dark grey hornblendic rock; 2*nd*, a pegmatite, consisting of orthoclase, oligoclase, quartz, and epidote, without a trace of mica or hornblende; 3*rd*, a metamorphic rock, consisting mainly of felspar and quartz, with muscovite or biotite; 4*th*, a granulite. A remarkably large vein of milky quartz is found 5 miles to the south of Wudjar Curroor in the first-named rock.

To the east of Wudjar Curroor, chiefly after a storm, the natives go about in rocky and uncultivated places looking for diamonds. The heavier the rains, the greater chance there is of finding some precious stones in the rainwash; but, according to M. Chaper, even when the search thus made is successful, the measure of success is so small as hardly to repay the amount of time consumed in it.

The natives stated that they generally found precious stones in the pegmatite and metamorphic rock. Chaper had diggings made at different points in these rocks, and he found two diamonds, two sapphires and three rubies, and this before washing and sorting the material. Nothing was found after washing and sorting. The diamond is crystallised in octahedra; its faces are less smooth, and its intersection angles less sharp than those of Griqualand West diamond. It is accompanied by corundum of various shades of blue and red, but having no crystalline form None of the other minerals usually found with diamond (rutile garnet, zircon, sahlite, hematite, etc.) have here been traced.

R. E. ITEMS.—The two new Field Companies of Royal Engineers will have a dismounted strength of three officers, one warrant officer, eleven non-commissioned officers, and 65 Sappers. The mounted strength will be one Quartermaster Sergeant, four non-commissioned officers and 19 drivers, trumpeters, and smiths. A third additional Field Company will shortly be raised, and the 11th Company, now at the School of Military Engineering, Chatham, will be absorbed in a new Fortress Company. This will leave the number of Fortress Companies still fourteen, nine of which are at present abroad.

THE PANAMA CANAL.—An English expert, who has recently visited all the sections of the Panama Canal and entered into a thorough examination of the work done and of the work yet to do, reckons that forty millions have been already expended, and that eighty-eight millions more will be required. Up to the end of last year it was estimated that 30,000,000 cubic metres had been excavated along the whole line of the Canal, and that there remained 120,000,000 cubic metres yet to be removed. The cost of blasting and moving a cubic metre of rock in the Isthmus is set down by the expert above referred to at 16*s.*, and of moving the same quantity of earth at 8*s.* These figures may be allowed to speak for themselves. Lord Lawrence is credited with having exclaimed, when a new canal scheme was laid before him, "Good heavens, these engineers think in lakhs." It is clear, however, that M. de Lesseps and his subalterns have got far beyond this, and "think in crores."

THE EGYPTIAN RAILWAYS.—The report of Sir H. D. Wolff on the administration of Egypt in reference to the railways states that the expenses of working the lines have been for several years less than the average working expenses of European railways, but this low rate of working is due to the fact that the lines have been allowed to fall into a deplorable condition of disrepair. No expenditure has been incurred which could possibly be postponed either in maintenance of the way or works, or in the repair of the rolling stock. The constant differences which have arisen between the administration of the railways, the Minister of Public Works, and the Council of Ministers have been destructive of any policy calculated to increase the traffic of the railway, or to maintain the property in a satisfactory condition. To ensure the security of the service it is necessary to construct works costing £161,500, and to do repairs. The rolling-stock is in a very bad condition and requires much repair. The conclusions arrived at are that the railways are susceptible of great development by means of a large reduction of rates, which would augment the revenue of the State, increase the profits of industry, add to the value of land, and result in other advantages.

General Articles.

THE NEW MARKET AT BARODA.

AMONG the many improvements introduced into the city of Baroda by the enlightened rule of the existing Gaekwar is the widening of streets and the clearing of open spaces. On one of the latter near the Swar Sagar Tank it is proposed to erect the handsome market which appears in our illustration. The design (by Mr. Chisholm) is interesting, as it exhibits a style of native art not hitherto pressed into service by modern requirements.

The forms made use of are essentially constructive, and may therefore be considered much purer than the more picturesque styles which eventually led to the florid and debased work characterising the advanced marble structures of Upper India. There is a simple Greek feeling about some of the forms which suggests a much more extended use. The materials will be red brick with grey sandstone ashlar dressings.

The elevation forms one side of a square roofed in with corrugated iron supported on iron columns.

THEORY AND PRACTICE OF SURVEYING.*

A REVIEW.

THIS work on Surveying aims at being very comprehensive, and it certainly contains a vast amount of information, well and carefully arranged. The type and general get-up of the book leaves nothing to be desired in this direction, but taking the work as a whole we are rather disappointed in it. It is too voluminous and bulky for a text book, but not complete enough to rank as a work of reference. It may describe all the surveying instruments commonly used in America, but it certainly does not mention all those in ordinary use in England or India. For example, no mention is made of the ordinary Dumpy Level. Again, some of the adjustments of instruments, as described, are unnecessarily complicated, not to say misleading.

So much for the defects, which are few, compared to the good points. The book teems with valuable practical hints on the care of instruments and the precautions that should be taken when using them. Referring to the level, the author states :—" The objective is always properly centred and adjusted when the instrument leaves the makers' hands ; but it is apt to become loose in its frame, and this frame also loosens in the telescope tube. If the glass is loose in its frame, unscrew it from the telescope tube, and screw up the tightening band from the rear side. *Do not take the glasses apart under any circumstances*, for they are ground for a given relative position, and would not be true for any other." We do not remember meeting with this caution in any other work on Surveying, and we quote it at length as an example of one of the many practical hints with which the book abounds. The first part is devoted to a description of instruments used both in the Field and in the Drawing Office, and the second part deals with the various kinds of surveying operations which are divided under the heads, Land, Topographical, Railroad, Hydrographic, Mining, City and Geodetic Surveying. One chapter is devoted to the measurement of volumes, and contains the usual rules for estimating earthwork.

The different modes of surveying are treated from quite an American point of view, and if their mode of procedure differs from that in common use with us, still there is much in it which we might with advantage adopt, and on this ground alone we consider this work is likely to prove a valuable addition to an Engineer's library, even if it had nothing else to recommend it.

The chapters on Hydrographic and Geodetic Surveying are exceptionally good and will repay careful study. The work concludes with a chapter on projection of maps, and various tables of general utility, so as to render it sufficiently complete to enable the student to solve the ordinary problems which arise in surveying. The illustrations are particularly well got up and we can confidently recommend the work to those who desire to gain good practical hints on the various methods of surveying enumerated above.

* By J. B. Johnson, C.E. New York : John Wiley & Sons. 1887.

REPORT ON THE PREVENTION OF THE WASTE OF WATER.

BY S. TOMLINSON, ASSOC. M. INST. C.E., F. R. MET. SOC., DEPUTY EXECUTIVE ENGINEER, WATER WORKS, BOMBAY.

II.

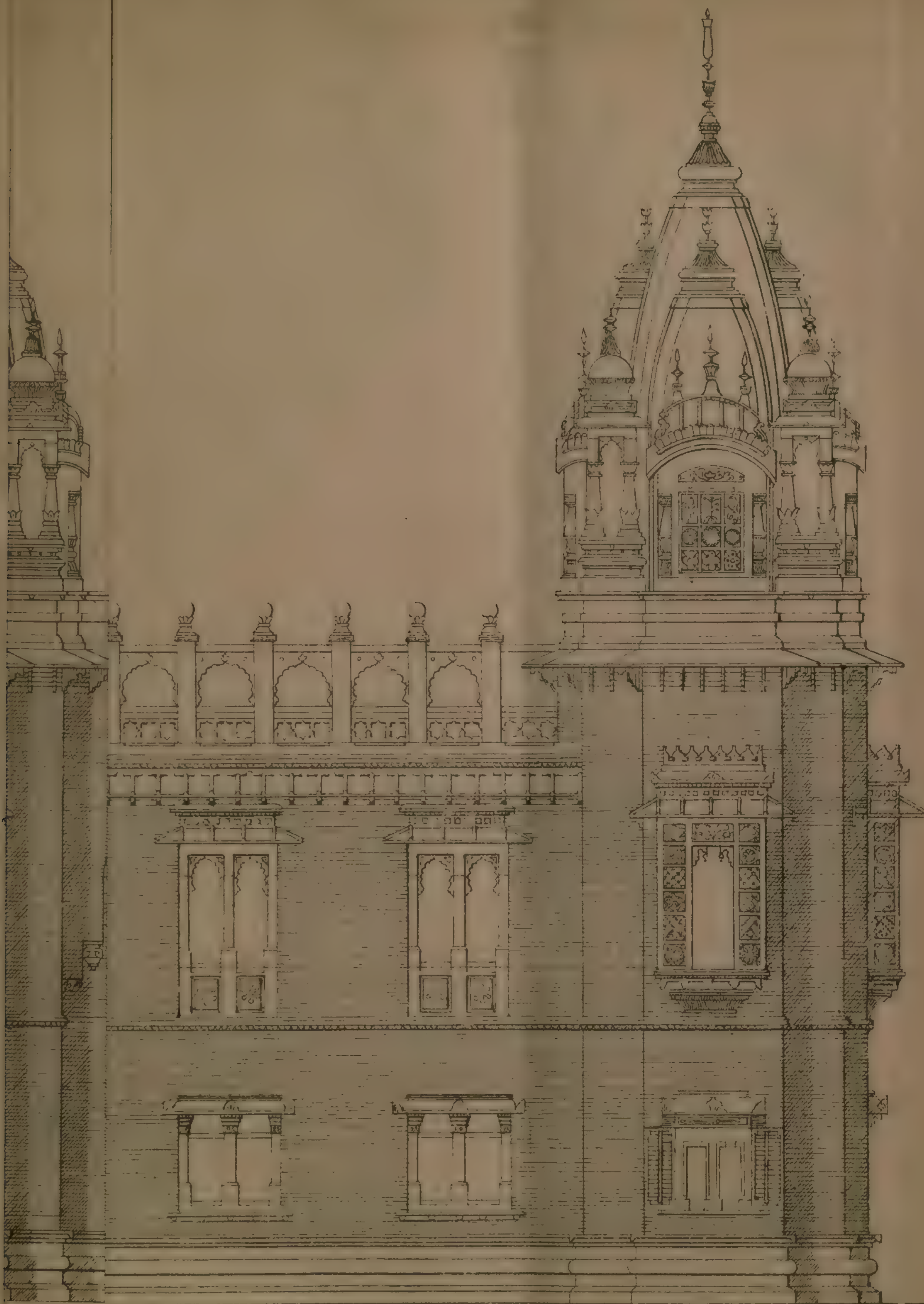
(Continued from page 305.)

I HAVE to report further on the work of the prevention of the waste of water, which has resulted since the middle of July last up to the middle of December, (five months only), in the net saving of 538,000 gallons per day of 24 hours over the whole district where constant supply is now given. Although I do not consider this a result which stands in need of any apology it should be pointed out that this saving is effected besides providing for the increased consumption of 75,000 gallons per day in those districts which have not yet been examined, marked with an asterisk in table I., which clearly shows that districts normally tend to grow worse and not better except by thorough examination, because more than usual attention, by ordinary means, has been given to those districts during the last few months. And as the consumption for the periods before inspections was in most cases in the months of July and August, some allowance should also be made for street watering and the generally increased demand for all purposes, besides the special one for gardens, which forms the subject of the latter portion of this report.

2. The Municipal Commissioner's instructions in his circular No. 7486 of the 11th September 1886 were duly carried out on the 1st October when the Waste Prevention Staff came under the control of the Chief Inspector. Until the usual Inspection Staff becomes well acquainted with the work and until the wards have been examined, once at least, I have assumed the more direct charge of the Waste Prevention Staff and work. In the closing days of September, I called together the staff interested in the work and gave four explanatory lectures on the system which, I hope, may have been of some service in giving a uniform method and aim to the staff. I am well satisfied with the way the change has worked. Instead of the Inspectors working two or three in one district I have appointed one Inspector only to a district to do everything in connection therewith—the picking up of boxes in the streets, night-inspections, day-inspections, writing out and serving notices, and re-inspections. In this way, the results obtained and the work done by each Inspector can easily be estimated.

3. Constant supply has been maintained in all the districts named in the former report, and has been extended to Khetwadi, Gowalia Tank Road, Nepean Sea Road, Narayen Dabulkar Road, Warden Road or Breach Candy, Walkeshwar, Sewri and Ghorapdeo, and in December to Chinchpokli, Byculla, Matharpakadi and Agripada. At present, therefore, as is shewn on the accompanying map, the whole of F. Ward, G. Ward (Mahim and Dharavi 16 hours only), E. Ward (Mazagon excepted), and a large part of D. Ward, with a total population of over 200,000 are under constant supply. It is satisfactory to find from, the following returns that this is not being done at the expense of drawing down the lakes so as to endanger the future supply.

IN



W. M

litho.

THOS D. BONA, Supdt

future supply.

COMPARATIVE HEIGHTS OF LAKES.

VEHAR.		Fall.
16th Oct. 1885......58·10	15th Jan. 1886......53·80	4·30
16th „ 1886......59·50	15th „ 1887......55·20	4·30
Diff. + 1886 ..... 1·40	Diff. + 1887...... 1·40	

TULSI.		Fall.
16th Oct. 1885 .....48·90	15th Jan. 1886......40·80	8·10
16th „ 1886 .....56·50	15th „ 1887......50·00	6·50
Diff. + 1886......7·60	Diff. + 1887 ..... 9·20	

4. 1,637 notices have been served during the 4 months (September to December) for the following purposes:—

979 Stop-cocks out of order.
241 Service pipe leaks.
161 Bib and ball-cock leaks.
20 Waste from defective tanks and cisterns.
226 Miscellaneous.

The total number issued during the year 1885-86 was 3,535.

5. I regret that, owing to delays on the part of the maker, an extended trial, as authorised by the Municipal Commissioner in his No. 9039 of the 20th October, of the proposed new stop-cock has not yet been made. The stop-cocks have just been received and will be fixed shortly. Meanwhile the experience of the last 4 months justifies the condemnation of the present system and the need for a better.

6. In consequence of unusually severe complaints, an examination was also made of Mugbhat, Girgam Road, but the district cannot yet be placed on constant supply. The dipping wells throughout the city have also been tested, and in several cases considerable leakage has been found. I think, when constant supply is fairly introduced and the necessity for storage does not exist, these wells should be abolished, and, if a free supply is still to be continued, taps might be substituted. I regret that no effective substitute has yet occurred to me to replace the spring taps now in use at public fountains which give so much daily trouble and cause so much waste of water by getting out of order.

7. With a view to reduce the expense of the system arising from the large number (at present above 500 per month) of diagrams used and to be tabulated, and the clocks to be kept in good repair, I have the honour to submit a substitute for the drums, diagrams and clocks for use in the monsoon, when so many diagrams get wet and torn and therefore useless, and the clock fittings become rusty and dirty; and, also, generally, when a district is not especially under examination, but requires watching only—to detect any outbreak of waste—which an examination of the diagrams of any district shews is needed, time after time a great increase being found in the night-consumption. As this is, generally, due to one or two defects, prompt attention frequently discovers them, whereas, if allowed to accumulate, the work becomes tedious and difficult. On the graduated plate (fig. 3) the rate of flow at any moment can be read off, and these registrations being taken at a certain hour of the night regularly will afford an indication of the general consumption of the district with reference to its previously determined normal condition. This has not yet been tried,* but the apparatus is so simple that there appears to be no reason why it should not answer its purpose.

8. At the close of the former report the increase of staff required was referred to. The number of Inspectors there stated—thirty—is about the number which will ultimately be required to keep the city in order when all under constant supply. The present staff of Inspectors is twelve—one is required to keep the clocks and meters in repair, and one to fix and remove diagrams, leaving only ten for actual inspection-work, in addition to the special Inspectors. In Liverpool, where the city has for some years been under this system and no special work is to be done now, there is a staff of forty-one persons engaged, thirty-six of whom are on inspection-work in 220 districts, equal to five districts per person. This number does not include the keeping in repair of the clocks and meters, which is done in the separate department where the meters are made. At Bradford, where valuable results are being obtained, I find there are six Inspectors at present to 26 meter districts equal to 4½ districts per person. These are all practical plumbers of much experience, and well-trained men to begin with. I must strongly urge that not less than ten Sub-Inspectors should be appointed at once. They will be to train for the work and for some time will not be fully efficient. The district under constant supply now will require not less than six Inspectors to maintion the ground which, once occupied, should never be left again. To detach six from the present saff would render it impracticable to push the work into the other portions of the city, where equally valuable results will no doubt be obtainable, for it should be noted that Nagpada and Kamathipura were the districts attended to, before I came, by the Inspectors sent out with the meters, and hence should be better than the rest of the city. Khetwadi, a new district, bears this out, the night line having been reduced from 12,000 gallons per hour to 7,000, and the daily consumption reduced by 71,000 gallons, and the examination is not yet completed. The saving of 600,000 gallons per day already effected reckoned at annas 4 per 1,000 gallons is worth Rs. 150 per day. If the whole of the present staff were to be kept to maintain merely this saving, the whole of their salaries amounts to but—

		Per month. Rs.	Per mensem. Rs.
12 Sub-Inspectors	@	30	360
2 Special Inspectors	„	150	300
26 Coolies { 12	„	10	120
{ 14	„	9	126
		Per mensem...Rs.	906
		Per day to...Rs.	30

Financially, therefore, there is much to support the proposed increase of staff, because it obtains a further available supply at a merely nominal cost (⅘ths of an anna, say 1 anna per 1,000 gallons), and there are complaints of want of water from those who pay 12 annas for it; as well as for urgent domestic use and sanitation. I therefore earnestly press for an increased staff to be given at once.

9. The prevention of absolute waste practically amounts to an increase in the storage capacity of a water works concern and its capability to yield revenue; very closely allied to it, in the latter respect, is the determination of the relation existing between the different portions of a supply and the payments made on account of it. The whole supply to Bombay is, from a revenue point of view, divisible as follows:—

(1) Meter supplies at annas 12 per 1,000 gallons or compounded sums checked by meter.

(2) Meter supplies to Government, Port Trust and Municipal properties at annas 8.

(3) Meter supplies to Churches and Schools, &c., at annas 3 or annas 6 per 1,000 gallons—24 at 3 annas, 31 at 6 annas.

(4) Supplied under assessment at 4 per cent. on the net valuation.

(5) Supplies to Religious and Charitable Institutions at nominal rates varying from Rs. 5 to Re. 1 per annum —130 at Rs. 5 and 14 at Re. 1.

(6) The free supply to dipping wells and fountains.

(7) Road watering, flushing of drains, public urinals, latrines, &c.

(8) Waste.

(To be continued.)

*Has since been tried and found satisfactory.

THE WRECK OF THE *TASMANIA*.

When a large ocean steamer is wrecked with possibly some loss of life, and necessarily a great destruction of property, the general public are apt to apportion the blame on grounds that are insufficient. Moreover, the attention of the public is naturally fixed on the dramatic episodes. On the other hand, to a court of inquiry the chief question is—why was the ship wrecked? Everything that followed the striking on the rock is, so to say, treated as secondary and accidental. But it is on these after features of the wreck that the public interest is naturally chiefly fixed. Before the ship struck we had questions of correct navigation, or of good judgment in one or two men. Afterwards we have the questions of courage, presence of mind, loyalty, tenderness, in a hundred men and women. If all the after incidents were noble, the error that produced the wreck is naturally judged too leniently. If many of the after incidents were discreditable, the error that caused the wreck is easily judged too severely.

Now, while each case of shipwreck has its special features of the highest interest—the conduct of men and women in situations of great peril—there is one feature which appears with painful regularity in most cases of shipwreck. That feature is the mismanagement of the boats. All systems of discipline—military, naval or otherwise—imply and adopt the commonsense principle, that men can only be depended on to do anything difficult in a time of danger when they have been accustomed by great frequency to do the same thing in the absence of danger. In other words, the power of habit is utilised to the utmost possible degree. If you want troops to fire straight and with regularity at a rapidly advancing enemy, you must first teach them to fire straight and with regularity at a motionless, lifeless target. If you want ten men to lower a boat in the night and when the waves are running high, have you already made it a certainty that they will do it properly when there is daylight and a smooth sea?

A tolerably extensive experience of large passenger steamers in various parts of the world enables us to assert that anything like boat drill is usually conspicuous by its absence. For this there is, perhaps, a reason presently to be given. Meanwhile let us remember that, in an ordinary well managed steamer, each boat has its particular crew already told off. The question, however remaining, does each man, so told off to a particular boat, vividly realise that his duty lies with that boat? He will so realise it if he and his fellows that belong to that boat do with some regularity find themselves collected in that boat. But otherwise he will not realise it in moments of safety, and therefore he will not realise it in moments of danger.

Suppose that a steamer carries a dozen boats for the safety of the passengers and crew. Suppose it were enjoined upon the captain that once a week there should be a boat drill. Suppose this drill consisted in a particular boat being really placed in the water entirely free of the ship except by a connecting rope. Suppose the boat was on such occasions supplied with a cask of fresh water and all other necessaries and that the crew really used their oars and pulled a dozen strokes. This would be an effective boat drill. A year or two ago a steamer ran at night on a sunken rock. The best boat was lowered first without sailors in it and a man stood on the deck of the steamer with one end of a rope in his hand. It was assumed by all that the other end was fastened in the boat. But when the man on deck hauled on the rope it came easily to him while the boat drifted away and was lost for six hours. Had there been in that steamer a boat drill it would have been some one's duty to see that the rope was made fast in the boat. When the lascars on the *Tasmania* tried to make off in the first two boats which they lowered they lost these boats by omissions equally absurd.

The lowering of a boat in calm weather is not a difficult nor a protracted business. If it is so, the drill should be increased till the lowering becomes easy and rapid. Instead of one boat being lowered at one time—a plan which would require a dozen drills before all the boats were overhauled and every crew drilled once—it would be preferable to lower two boats at the same time. Thus the crews would compete with each other, the work would be made more interesting and the men made more smart. In every ship's crew we may expect to find some of the men insubordinate in time of danger, or they may be panic struck and so be worse than useless. In a proper system of effective boat drill these lawless or cowardly natures are likely to be distributed among the rest of the ship's crew. Then in each boat's crew we may expect to find some more trustworthy men who will exert a healthy influence over their worse companions. Moreover, the insubordination or cowardice will be much reduced by the discipline and by the *esprit de corps* that will be created in the crew of each boat.

We have yet to learn whether the lascars who tried to lower the first two boats were the proper crews of those boats. Probably they were not. They probably consisted of the most impressible men collected together accidentally at the moment and having no connection with each other except their greater absence of courage or greater want of loyalty. This rapid and instinctive banding together of the worst elements to demoralise the others by their example would be checked by a habit that attaches each man to a particular boat. With this habit already formed the crew of any one boat would be likely to resent the appearance there of sailors that did not belong to it. And as the best sailors would be at the posts already assigned to them these accidental appearances would be those of men who were treacherous or who had lost their senses through fright. In a moment of danger the remonstrance of a comrade is more efficacious on a panic struck man than is the remonstrance of an officer. We are naturally most sensitive to the judgments of our equals.

Matters may have changed lately, but a few years ago the ordinary captain of a merchant vessel was no friend to life belts or to other life-saving appliances. He would, of course, have a few life buoys in case of a sailor falling overboard while reefing sail or being washed overboard by a wave. But he disliked the idea of every sailor having a life-saving appliance specially his own to use. If the captain formulated his prejudice he would express it somewhat as follows:—"If you want to make a man a good sailor let him feel that his safety lies in the safety of the ship. The easier you make it for him to desert the ship in times of great danger or hardship the less likely will he be to do his best to save the ship from foundering or from a lee shore." Now, we must admit that there is some sense in this argument. Moreover, the argument is not peculiar to sailors. When a general burns the bridges behind him he is reasoning about human nature in a manner precisely the same.

If the argument seems good against the multiplication of life belts or life rafts, it would by a captain be felt to apply also to boat drills. For instance, a boat drill contrasts strongly with a fire drill. The fire drill contemplates an ultimate victory over the fire—a remaining of the crew in the rescued ship. A boat drill contemplates a possible defeat—the ultimate desertion of the ship. The instinct of a captain makes him dislike any entertainment of the idea that it may ever become necessary to desert the ship. This is probably the real reason why boat drills are so avoided. If a ship is lost but all hands are saved the common sailor does not lose much. The captain, however, may lose his reputation. He may also have been part owner of the vessel or cargo. Thus the captain is likely to feel that his own interests and those of the crew are not altogether identical and he is indisposed to encourage them to give up too soon their struggle with wind and wave.

THE GEOMETRY OF THE OBLIQUE ARCH.

By A. Ewbank.

V.

Fig. 11.

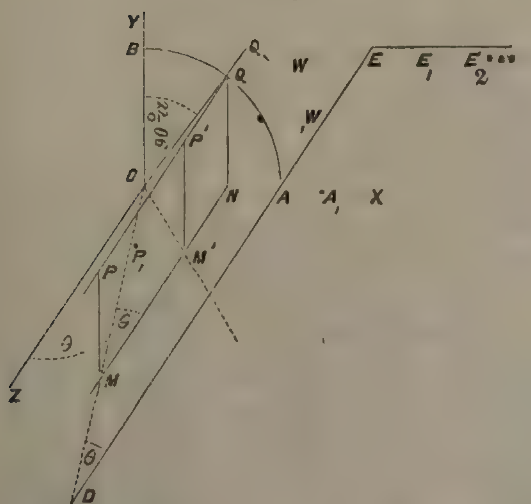
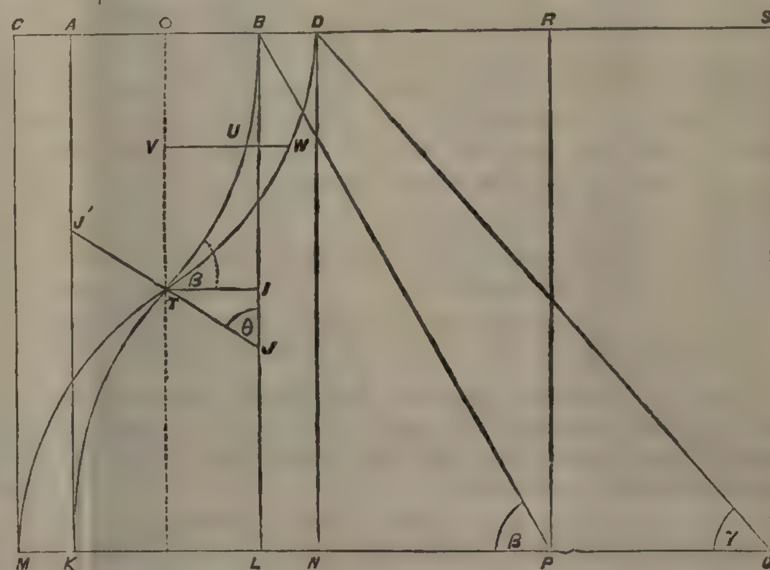


Fig. 2.



If we consider P as a part of the vertical plane y O m (*fig.* 11) we see that different points of the indefinite line M P have different values for y. But for each the x is the same and $=$ O N and also for each the z has some particular one value, *viz.*, M N. Moreover, these values of x and z are connected by the relation $z = x \operatorname{Cot} \theta$, for O N M is a right angle. This is sometimes called the equation to the plane y O M.

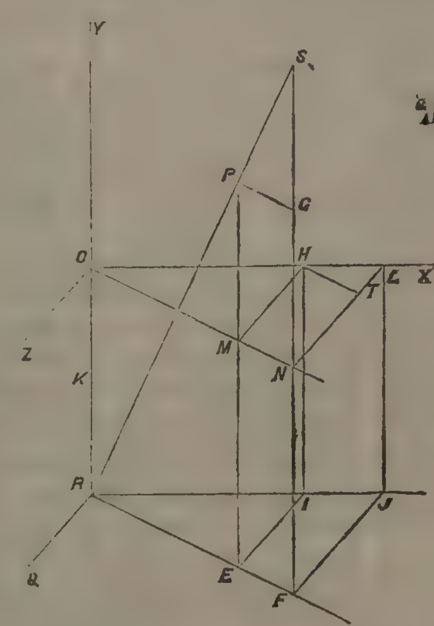
It will be observed that for the spiral A_1 P_1 we have the pitch different from β. This was illustrated in *fig.* 2 where the new pitch was called γ. We will here call the new pitch β_1 and $m_1 = \tan \beta_1$. Similarly $m_2 = \tan \beta_2$, $m_n = \tan \beta_n$. This final pitch we might call γ but we shall not have occasion to use it. Our concern is with the first spiral line A P and that one of the same *group* which immediately follows. That is we deal with the point P and the next point S_1 in the arch face. As the length A A_1 is taken smaller and smaller the line P S_1 ultimately becomes the tangent at P to the locus P S_1 S_n; and the behaviour of this tangent line is what we have to study.

When A P has made one half turn we have $x = r \operatorname{Cos} \pi$, $y = r \operatorname{Sin} \pi$, $z = m\, r\, \pi$ where π is 180° in circular measure. Similarly when A_1 P_1 has made half a turn $z_1 = m_1\, r_1\, \pi$. But $z_1 = z$. $\therefore m_1 r_1 = mr$. Thus the *group* of spiral lines now under review are connected by the relations $mr = m_1 r_1 = m_2 r_2 = \ldots = m_n r_n$. $r_n - r$ is the length C A or E F of *fig.* 1. $r_1 - r$ may be considered a dimension of one of our stone blocks and this may be as small as we please. We may in the limit imagine ourselves building arches with stones infinitesimally small. We have now to study the direction of the straight line or chord P S_1.

The spiral A P passes through the point A. The other spirals of the *family* of A P—having the same pitch and traced on the same cylinder—meet the circle A Q B at different points. Now of these spirals—or intradosal lines—let us consider that one which passes through the crown B of the arch. We may say that it starts from some point E in D A produced (see *fig.* 11) and from it is developed a *group* of spiral lines, *viz.*, E B, E_1 B_1, E_2 B_2, &c. The points B, B_1, B_2, are all in Oy and therefore the thin male screw made by this group is a surface which is cut by the arch face along the line O y. In this case the arch face cuts a screw surface along a *straight* line. If therefore there is some one point R through which pass all the tangent lines to the face coursing lines, this point R must lie in the line O y or in this line produced upwards or downwards. We begin by finding that point R where the tangent line at P to the curve PS_1 meets the line O y. The figure suggests that the point R will be below the plane x O z.

In *fig.* 10 *a*, S_1P R is the line which, when S_1 moves down its curve to P_1 will become the tangent line at P_1. Through R on y O produced draw R J parallel to O x and R Q parallel to O z. Thus J R Q is a plane parallel to x O z. As before (see *fig.* 10.) P M $= y$, M H $=$ z, H O $= x$. Similarly the point S_1 is defined thus,—$y_1 = S_1$ N $z_1 =$ NL ; $x_1 =$ OL.

Fig. 10 *a*.



The plane R P M cuts the plane Q R J in the line R E F which is parallel to O M N. The planes M H I E, N L J F are parallel to the plane yOz, P G is parallel to M N or E F or H T.

By similar triangles $\dfrac{\text{R P}}{\text{P S}_1} = \dfrac{\text{R E}}{\text{E F}} = \dfrac{\text{R I}}{\text{I J}} = \dfrac{\text{O H}}{\text{H L}} = \dfrac{\text{O H}}{\text{OL} - \text{OH}}$

also $\dfrac{\text{R P}}{\text{P S}_1} = \dfrac{\text{F G}}{\text{G S}_1} = \dfrac{\text{F N} + \text{N G}}{\text{G S}_1} = \dfrac{\text{O R} + \text{P M}}{\text{S}_1\text{N} - \text{P M}}$

also $\dfrac{\text{R P}}{\text{P S}_1} = \dfrac{\text{R E}}{\text{E F}} = \dfrac{\text{O M}}{\text{M N}} = \dfrac{\text{O H}}{\text{H L}} = \dfrac{\text{M H}}{\text{T L}} = \dfrac{\text{M H}}{\text{N L} - \text{M H}}$

Therefore $\dfrac{\text{O H}}{\text{O L} - \text{O H}} = \dfrac{\text{O R} + \text{P M}}{\text{S}_1\text{N} - \text{P M}} = \dfrac{\text{M H}}{\text{N L} - \text{M H}}$. If we put k for the length of O R we have $\dfrac{x}{x_1 - x} = \dfrac{k + y}{y_1 - y} = \dfrac{z}{z_1 - z}$.

By taking the first two fractions we get $k = \dfrac{x y_1 - x_1 y}{x_1 - x}$.

By taking the last two fractions we get $k = \dfrac{z y_1 - z_1 y}{z_1 - z}$

These two values ought therefore to be equal. And if

we remember that P is in the plane B O D of *fig.* 11 we have $z = x \operatorname{Cot} \theta$. Similarly $z_1 = x_1 \operatorname{Cot} \theta$. Thus the latter value of k is $\frac{x y_1 \operatorname{Cot} \theta - x_1 y \operatorname{Cot} \theta}{x_1 \operatorname{Cot} \theta - x \operatorname{Cot} \theta}$ which equals the former value.

We have for P, $x = r \operatorname{Cos} a$, $y = r \operatorname{Sin} a$, $z = m r a$; also $z = x \operatorname{Cot} \theta$. For S_1, $x_1 = r_1 \operatorname{Cos} a_1$, $y = r_1 \operatorname{Sin} a_1$, $z_1 = m_1 r_1 a_1 = x_1 \operatorname{Cot} \theta$.

$$\text{Thus } k = \frac{z y_1 - z_1 y}{z_1 - z} = \frac{\operatorname{Cot} \theta \{x y_1 - x_1 y\}}{z_1 - z}$$

$$= \frac{\operatorname{Cot} \theta. \{\operatorname{Cos} a \operatorname{Sin} a_1 - \operatorname{Cos} a_1 \operatorname{Sin} a\} r r_1}{m_1 r_1 a_1 - m r a}$$

$$= \frac{\operatorname{Sin} \overline{a_1 - a} \operatorname{Cot} \theta. r r_1}{m r a_1 - m r a} = \frac{r_1 \operatorname{Cot} \theta}{m} \times \frac{\operatorname{Sin} \overline{a_1 - a}.}{a_1 - a}$$

Now as long as P S_1 is a chord of finite length this value for k depends partly on the values of a and a_1. But if the point S_1 is moved along its curve to P, the radius r_1 becomes reduced to r, and the angle a_1 becomes equal to a. In this case the fraction $\frac{\operatorname{Sin} \overline{a_1 - a}.}{a_1 - a}$ (or $\frac{\operatorname{Sin} \delta}{\delta}$ where δ is a vanishing angle expressed in circular measure) becomes equal to unity. Thus the *tangent* line at P cuts y O produced in a point R such that $\text{O R} = \frac{r \operatorname{Cot} \theta}{m}$.

(*To be continued.*)

THE MADRAS HARBOUR.

Its Construction, Destruction and Reconstruction.

XI.

When Mr. Molesworth's report reached the Government of India, it seems to have been referred to Colonel Brownlow, R.E., the Inspector-General of Irrigation, and he expressed full concurrence with the opinions expressed and the recommendations made in it, except that he would increase the number of blocks in the random work to 10½ per 4½ lineal feet, and provide for the cost of increasing the *specific gravity* of the blocks laid on the outer face of the work, Mr. Parkes' blocks being of 25 per cent. less specific gravity than the blocks found necessary for the protection of the foreshore at Tynemouth. Taking all things into consideration, Colonel Brownlow thought that 35 lakhs of rupees would be a more correct estimate than either 27 or 30 lakhs.

The Master Attendant of Madras, Captain J. H. Taylor, R.N.R., next had his say, and he drew the attention of Government to the question of the comparative strength of the sea that caused the disaster. He claimed to have had many opportunities of observing cyclones and estimating their wave action, and he had always said that the attack on the works at Madras on the 12th November was a very mild one. He therefore submitted the opinions of the officers of his Department and of the boatmen of the Port, from which it would be seen that there was no difference of opinion upon the point. We have already quoted the opinion of Mr. Marshall, the Deputy Master Attendant, and the opinions published are equally strong to the effect that the sea in the cyclone of 1872 was infinitely higher than in the "rough weather" of November 1881. Colonel Sankey in sending up these opinions of nautical authorities pointed out that they confirmed the view he had expressed in his note on Mr. Parkes' reconstruction report above quoted, and he also stated his own recollection of the sea in a cyclone in 1856. But he would not have dwelt at length on this point had not Mr. Parkes "based his restoration scheme almost wholly on the effects of the late cyclone as, in his opinion, having been one of maximum intensity, or, to use his own words, 'one of those great historical cyclones,' whereas the facts, as vouched for by the officers of the Department best capable of judging, appear to point to a very different conclusion." Thereupon these papers as to the comparative strength of the sea were forwarded to the Government of India and the Secretary of State, and they in due course reached Mr. Parkes, who in a reply addressed to the Under-Secretary of State said that the evidence they contained added nothing material to the information furnished to him at the Master Attendant's office before he made his report. Other equally confident evidence to the contrary effect was then before him, and he reported that there was a conflict of evidence. He followed the course indicated by actual results, and proposed to apply additional strength to the places in the work that appeared weak, and that to an extent considerably beyond what was actually proved to be necessary. It was, therefore, with some surprise that he (Mr. Parkes) read the statement by the Chief Engineer that the late cyclone was in his (Mr. Parkes') opinion one of maximum intensity, and that his restoration scheme was based on this assumption.

He thought it, Mr. Parkes said, "possible that Colonel Sankey's misapprehension may have arisen from the fact that I made observed results the starting points for my recommendations, and abstained from adopting any conjectures as to what heavier seas might do in other directions than those indicated on this occasion. To do so would, in my opinion, be impracticable and unscientific. I look upon the construction of the Madras piers as an important experiment in engineering, of which the results are not confined to mere local benefits, and I should deplore on more than personal grounds a decision of the Government which would throw away the results of the late most important and interesting lesson."

Colonel Sankey's reply is so much to the point that we must quote it nearly in full; but he evidently at the time could not find the Gladstonian sentence we quoted in a previous article, in which Mr. Parkes had described the sea of the 12th November as having been "of nearly maximum force." Mr. Parkes had evidently forgotten all that he had previously written.

The quotation given by me in the paragraph adverted to was taken from paragraph 8 of Mr. Parkes' report of the 9th March 1882, which runs as follows :—

"The testimony of all observers is to the effect that the sea of the 12th November must rank with those of the great historical cyclones, though there is a conflict of evidence as to whether it was actually as heavy or 'heavier ;' "and then he goes on to quote his authority, Mr. Chisholm, who, he says, 'speaks confidently as to the recent sea being considerably heavier than that of 1872.'"

My remark that he had based his restoration scheme almost wholly on the effects of the late cyclone, as in his opinion having been one of maximum intensity, is, he observes, "unintentionally, no doubt, quite untrue." He is of course the best exponent of his own language, but I submit that I had somewhat strong grounds, as shown by the above quotations, for the conclusion I had arrived at. He now contends (paragraph 4) that the evidence furnished by the Master Attendant and other very experienced Marine officers "adds nothing material to what he had himself collected before making his report ; but in this case I think it may fairly be inquired why, with the evidence of the professional Marine Department open to him, he set this aside and only quoted that of the Consulting Architect, whose opinion, however valuable in matters connected with his own profession, must necessarily weigh but very little in a case of this kind, even had his opportunities for arriving at an opinion been exceptionally good, which would seem not to have been the case.

Mr. Parkes, in paragraph 7 of his present letter, observes that it would have been "impractical and unscientific," had he not made observed results the starting point of his recommendations, and abstained from adopting any conjectures as to what heavier seas might do with his work, and (paragraph 5) that, having ascertained the weak places in the work, he proposed to apply additional strength to those places, "to an extent considerably beyond what was actually proved to be necessary by the results of the late storm," &c. Now the sections given of Mr. Parkes' proposed restoration show (paragraph 30 of his report of the 9th March 1882) that the upper part of the completed work will have a thickness of only *three* concrete blocks, but, as noticed by me in paragraph 14 of my note of the 13th March, the piers at their ends where the thickness was *four* blocks had, as a fact, fared no better than where there were only *two ;* they had been equally knocked over in the 12th November storm. It is quite true that Mr. Parkes provides an iron cramp between his two front blocks, and also increases the weight of his rear block, but with all this I think it may fairly be questioned whether with these additions his section will be stronger than what it was at the end of the piers in the work which failed.

The principle, moreover, of only providing for meeting the shock of a storm which, as it now seems, Mr. Parkes does not consider to have been of "maximum intensity," seems to me wrong. It is the duty of the Engineer invariably to provide a sufficiently large margin, to ensure the safety of his work, and this is one of the chief points in which I cannot help thinking Mr. Parkes' design distinctly fails. As his wall should be constructed with the express object of withstanding intact the shock of the heaviest seas and breaking them up, he is bound, I consider, to allow a sufficient co-efficient of safety. He has not, I think, done this, and it is to my mind far from re-assuring to find, at the present stage of this great work, that Mr. Parkes is obliged to look on it as only an "important experiment in engineering."

The question of the reconstruction of the Harbour Works having been referred to the Secretary of State for India, that officer in July 1882 took the advice of a trio of eminent Engineers, consisting of Sir John Hawkshaw, F.R.S., Sir John Coode, the Consulting Engineer for the Colombo Harbour Works, and Professor Stokes, and their report was submitted in January 1883. The reports of Mr. Molesworth and Mr. Stiffe (who concurred in the main with Mr. Molesworth, but submitted a separate and very able report) and of Mr. Parkes, and the Notes of Colonel Sankey, and two letters from Mr. Dalrymple, late Master Attendant of Madras, were all referred to the Home Committee of Engineers, and they were requested to report, after unreserved communication with Mr. Parkes, their opinion whether the works could be so restored as to give reasonable expectation of their future stability, and, if so, what method of construction should be adopted to that end. Besides having frequent communication with Mr. Parkes, and receiving documents and information and opinions from him, the Committee had the advantage of interviews with Mr. Thorowgood, and of the attendance at one of their meetings of Mr. Dalrymple. They also took advantage of a visit paid to England by Mr. Molesworth to obtain his views on several matters.

The Committee considered the conflicting evidence as to the comparative strength of the sea during the two storms of 1872 and November 1881, and, while feeling unable to decide the question, they had no doubt, from the effects of it, that the latter storm was a very severe one. They, however, decided that it would be safer to assume that neither the storm of 1872 nor that of 1881 was necessarily a maximum one, as the period of nine years within which both had occurred was too short to justify such a conclusion. The Committee said that questions naturally arose as to whether any portion of the damage could be attributed to the mode of construction, or whether it arose entirely from the dimensions and mass of the piers being insufficient. Without concurring with Mr. Parkes as to the depth below which wave action might be disregarded,—

"For those depths must have relation to the magnitude and character of the waves and the weight and size of the material acted upon, yet, having regard to the magnitude of the seas then contemplated, the walls were founded sufficiently deep below low water, and the general outline of the design was not inappropriate, but there appears to have been difficulty in procuring suitable material for the rubble mound. Mr. Molesworth states that the size of the stones of which the rubble base is composed varies from 5lbs. to 2cwt., which is small for the purpose, especially where laterite is used, which varies much in quality and is sometimes so soft as to be easily still further reduced in size by the slightest movement.

The superstructure of the piers was not built of one bonded mass, but consisted of two parallel walls placed side by side in juxta-position, having a vertical joint between them; and from the portion of the walls on the harbour side of the piers having in places fallen away from the portion on the outer or sea-side, it seems probable that the pressure of water in the joints led in great measure to this result. The oscillation of the two halves of the wall, also caused by the want of bond and the consequent opening and closing of the vertical joint referred to in Mr. Molesworth's report, must be remedied, as it may in time prove mischievous. No doubt the method of building adopted by Mr. Parkes conduced to rapidity of construction, but were the work to be begun again, we could not recommend this method, but should prefer the work being bonded throughout.

The two drawings submitted by the Home Committee, consisting of a plan of the harbour, with the proposed method of restoration indicated on it, and a sheet of 5 cross-sections of the work, were produced as Plate No. V. with article IX., May 7. On the plan is marked the portions to which each of the first four cross-sections refers, the fifth showing a method of reconstruction with random concrete blocks as recommended by Mr. Molesworth.

The Committee thus described the works they recommended, and the order in which they should be carried out:—

For the landward portion of the piers, the works we recommend to be undertaken (shown on Cross-section No. 1) consist of cramping each pair of blocks in the upper course, and the addition of a mass of concrete carried up to 12 feet above high-water spring tides, the level to which we consider it necessary to raise the piers throughout their entire length. This mass of concrete and the cramping will prevent the oscillation of the two halves of the wall, and are necessary to remedy the want of bond we have referred to. We have not shown wave-breakers along the landward portion of the piers, but the rubble mounds should be carefully examined, and, where requisite, made good by gneiss rubble of large size, or by concrete blocks.

For the next length of the piers, extending to the elbows, in addition to the cramping and the top mass of concrete, a wave-breaker, shown on Cross-section No. 2, of random concrete blocks, should be added on the seaward face, which will render it necessary to widen the rubble mounds. The concrete blocks for the wave-breakers should nowhere be less in weight than twenty tons.

As respect the piers from the points B on the north pier and E on the south pier to the seaward ends, it would be desirable, if it could be done, to continue the walls on the original foundations, bonding the blocks in the manner shewn, strengthening and protecting the walls as they are built by wave-breakers, and depositing bags of concrete at the toe of the wall on the harbour side to form a continuous apron. (See Cross-section No. 3.) But picking up the blocks buried, or nearly so, in *débris*, for the purpose of resetting them, or preparing a sufficiently level bed on the site of the destroyed wall, will involve great labor and expense, and possibly even it may be found impracticable to continue the wall on the original foundations.

A more certain plan of procedure for the reconstruction of these outer lengths of the piers would be to move them into the harbour to the extent of about 60 feet, so that the new walls may clear the fallen blocks of the old structure, adopting the design shewn on Cross-section No. 4, and this would involve a somewhat less expenditure than building on the original foundations. But it would shorten the harbour—already very short—to the extent of about 60 feet; and also it would be undesirable, if it could be avoided, to build on a new foundation of unconsolidated rubble, instead of taking advantage of the old consolidated mounds.

The plan, therefore, we recommend for the reconstruction of the outer lengths from B on the north pier and E on the south pier, to the seaward ends, is in the first instance to endeavour to continue the walls on the old foundations, as shewn on Cross-section No. 3. Before the elbows of the piers are finished it will be seen whether this plan can be successfully carried out; if so, the system should, we think, be followed. If not, the piers should be brought in to the extent of about 60 feet, following the design shewn on Cross-section No. 4.

We have carefully considered the question of reconstructing these outer lengths from B on the north pier and E on the south pier to the seaward ends by mounds of random concrete blocks, more especially as the plan has been recommended by others. It possesses advantages, and as regards construction is a safe system to follow. But it would be necessary to build a short length of wall at the extremity of each pier, upon which to place the entrance lights, and, owing to the size of the vacuities, amounting to between one-fourth and one-third of the mass, the seas may pass through sufficiently to produce some disturbance inside. If the Madras Harbour were of larger size, and there were ample space for the waves to disperse, the system would be more applicable; but the sheltered area being limited, it is important that the whole space should be made as quiescent as possible. We have, however, thought it right to go carefully into the cost of reconstruction by adopting random mounds for these outer lengths, and find that there would, comparatively speaking, be but little saving in expenditure in adopting this mode of procedure, in preference to building walls on the original foundation with a wave-breaker (shewn on Cross-section No. 3), as recommended for adoption.

The order of proceeding with the works should be first to secure by iron cramps the top courses of the walls which are now standing, that is to say, from the shore to the commencement of the elbows; to reinstate the walls which have been disturbed or thrown down, carefully cramping the top courses together as the work proceeds, and simultaneously in both cases to proceed with depositing the blocks for the wave-breakers so as to afford early protection to the rubble mound and the walls. Raising the walls by concrete in mass will be the last process, as that portion of the work can only conveniently be done by beginning it at the outer extremities of the walls and working back towards the shore.

For the purpose of arriving at an estimate of the cost of reconstruction, we have assumed the definite lengths previously referred to for the different methods of procedure recommended to be followed and shewn on the Cross-sections. The details of the estimates are given in the Appendix. We estimate the cost of restoration, strengthening, and raising the piers at £480,000 (see estimate No. 1), assuming that the lengths from B on the north pier and E on the south pier to the seaward ends were reconstructed on the original foundation. If, however, these outer lengths of the walls were brought in 60 feet, the cost, we estimate, would be reduced to £430 (see estimate No. 2). We have also given an estimate of the cost, assuming that these outer lengths were reconstructed by random mounds of concrete blocks (see estimate No. 3). These sums are large, but, in our opinion, a smaller expenditure will not render the work secure. Even with this additional expenditure, the cost of the piers, having regard to their length and to the depth of water, will not be excessive.

In comparing their estimate of cost with that prepared by Mr. Parkes, the Committee said it must be remembered that his did not provide for raising the piers to the height they thought essential, and also that, for safety's sake, they had assumed higher prices than he had done. They called attention to the necessity of the materials and workmanship being of the best quality: no concrete block of large size ought to be used until at least three months after it had been made,—six months would be better: and they condemned the local laterite and prescribed gneiss for the rubble additions. They disapproved of altering the position of the entrance to the harbour, but recommended that the width should be reduced from 550 to 450 feet, and provided in their estimate for the cost of doing so.

(To be continued.)

SEWERAGE SCHEME FOR KARACHI CITY AND ITS SUBURBS.

By J. Strachan, M. Inst. C.E., Municipal Engineer.

(*Continued from page* 286.)

III.

11. The third objection taken in England to sewage farms should have little force in Karachi. In England crops raised by sewage irrigation have to compete with those irrigated by the ordinary rainfall and must naturally, unless of a very superior quality, be sold at a loss. In Karachi, however, where rain so seldom falls and where, in consequence, all crops are irrigated by artificial means, there is every reason to suppose that a sewage farm would be a commercial success.

Now comes the very natural question, would the application of town sewage to land be likely to cause nuisance or be attended with dangerous consequences? On this point I have already quoted the opinion of the Municipal Commissioners of the city of Paris, and of the Drainage Commissioners of France, I could also give various examples, Croydon for instance, where the sewage farm is not only not a nuisance, but financially a success as well, but I will content myself with merely quoting what a Parliamentary Committee of inquiry reports as the result of evidence taken, *viz.*, that sewage in the state in which it is found at the outfall of well ventilated sewers, even in the hottest weather, is very slightly offensive. If applied to the land in this state, and in such dressing as can be easily absorbed by the earth, no fear of nuisance need be felt, as the soil possesses the power to deodorize and separate from the liquids, all the manure which they contain provided that too large a quantity be not applied. Next to sanitary considerations comes, in England, the commercial value of the sewage. I do not, however, propose in this report to take up the question, as I am not in a position to say much on the subject. But, judging from the success of various Market Gardens in the neighbourhood of Karachi, I believe that the operations connected with it will be remunerative. This, however, will be, I presume, a secondary question with the Municipal Commissioners to whom a small gain or a small loss will be a matter of little consequence compared with the satisfactory disposal of the sewage. At Croydon, near London, the irrigation of land with the town sewage has been carried out most successfully. The method is very simple and inexpensive and resembles the mode of ordinary well irrigation practised all over India. The quantity of sewage water poured on the land at Croydon is 18,000 tons per acre per annum; at Rugby, where the sewage is stronger, it is only 9,000 tons. The chief crops to which the sewage is applicable are water grasses, cabbages, &c. In comparison with the above if 400 people to an acre of sewage farm be the proportion adopted under this scheme, and 20 gallons per head be taken as the total quantity to be discharged over 150 acres of land, the total discharge will be per acre per annum about 13,000 tons.

12. The site of the proposed sewage farm is not shewn on the accompanying plan but it is about 3 miles to the north of Trinity Church, a distance sufficiently great to render its location there unobjectionable. It will, however, be advisable that the proposal be freely ventilated and discussed, both by the Municipal Commissioners and the general public, and also that the Military and Medical authorities be asked for their opinion in the matter. The proposal will also have to be sent to the Sanitary Commissioner with the Bombay Government, whose opinion, as he knows Karachi intimately, will be of no small value in the settlement of the question.

13. The only party who may object to the scheme as now proposed is the Walli Shere Alli, whose country residence is about 1,000 yards to leeward of the site of the farm. If it be acknowledged that the scheme now proposed is the only one practicable under the circumstances, as I believe it is, steps will be taken no doubt to secure, if not his active co-operation, his passive acquiescence in it.

14. Taking it for granted, then, that the system of sewerage to be applied to Karachi is the water-carriage system, admitting into the sewers fœcal matter from closets as well as the house sullage and bath-room water, and that the sewage is to be applied to the land at the site indicated, it remains for me now to give a short description of the works which are included in the scheme now proposed.

15. As already stated the city of Karachi is practically without sewers of any kind. In 1884-85 several thousand feet of glazed earthenware pipes were laid down for the purpose of carrying off the waste water from a few of the cisterns at the stand-pipes in the native Town, but no house connections were made; at the time these pipes were laid down, the probability of their forming part of the entire sewerage scheme in the future was not lost sight of, and consequently, with the exception of the 12-inch pipe which at present acts as the outfall sewer and discharges itself into the Lukhmeedass drain, under the railway bridge, and a few smaller pipes in the town, these will remain undisturbed.

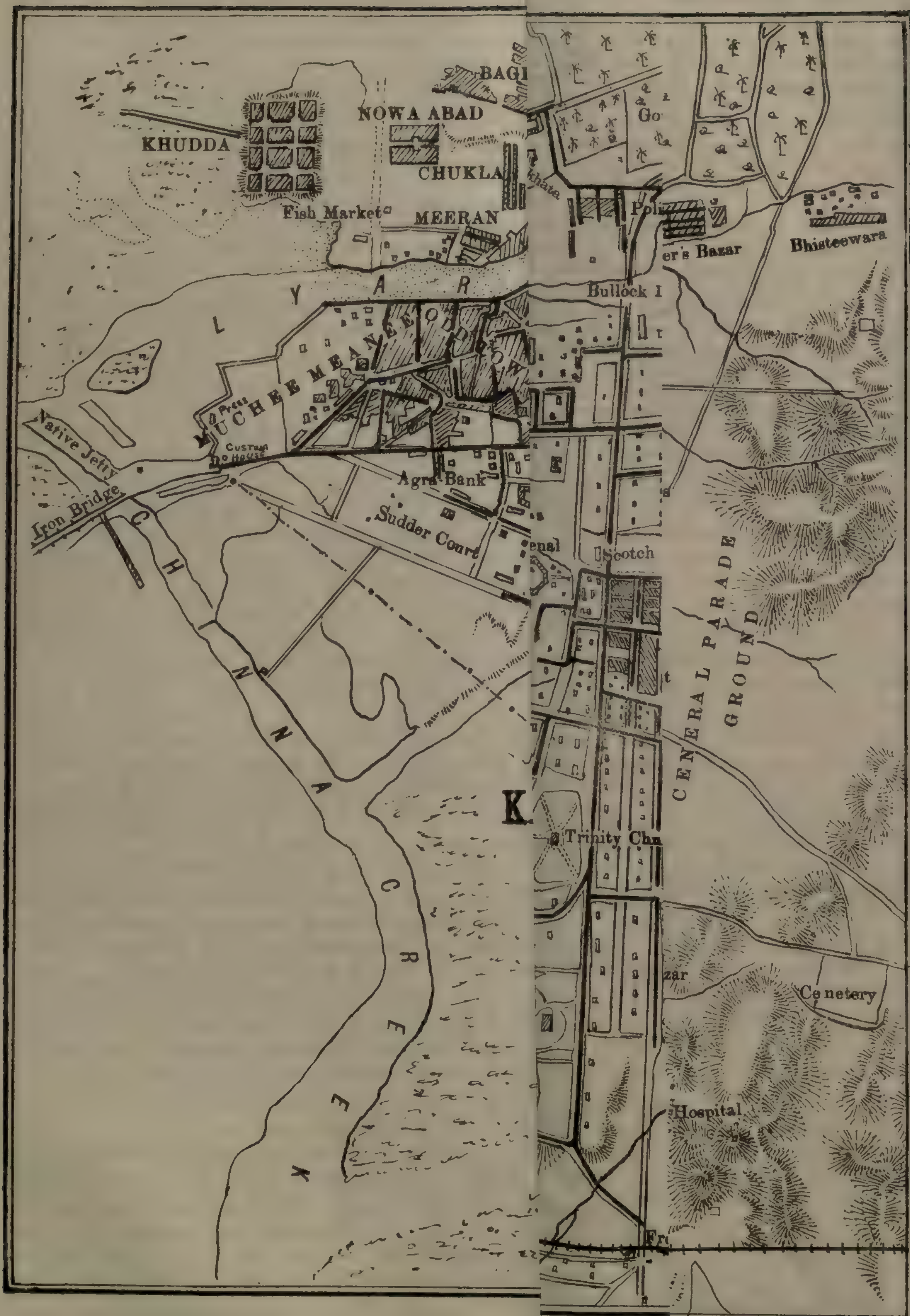
16. In dealing with the sewerage of Karachi that portion of the town which includes old Town Quarter, Napier, Jail, Bunder, Market Quarters, is the most important and will require special care and attention in consequence of the narrowness of its streets and lanes and the crowded state of its houses. Muchi Miani is not included in the present scheme as its general level is too low to admit of this being done, there will be no difficulty, however, in including the sewers of Muchi Miani in the general scheme when its level has been raised several feet. The hamlets on the trans-Lyari district are also not included in the present scheme. Clifton and Ghizree are likewise excluded. Beside the various quarters of the old Town, the scheme embraces the sewerage of Sudder Bazar, Civil lines, and the Military lines. It would be a great error in my opinion to exempt the Military lines and I would recommend that negotiations be opened up with Government, relative to this point and to the share of the cost which they should be called on to bear in reference to it. The area affected by the proposed works will therefore be comprised within the following boundaries:—

From the Custom House to the Clifton crossing and thence to the Cantonment Station crossing, including the bungalows in Frere Town.

From the Cantonment Station crossing, along the back of the Napier and Native Infantry Barracks to Soldiers Bazar; thence to a point on the river bank opposite Dhobee Ghat along the banks of the river to Paria Street; thence along Paria Street and Muchi Miani Road to the Custom House. This area measures over 2,900 acres.

17. The new sewers to be laid in the street of the Town and Camp will be glazed earthenware pipes varying in diameter from 3 to 12 inches according to the duty required of them. From the experience already gained it is evident that pipes larger than those generally laid in towns will have to be used here, as it is the custom to wash into the drains much solid matter that should otherwise find its place in the dust bin.

18. For the Town, two intercepting sewers will be provided. The cross drains will fall from the centre of the Town on each side towards the intercepting sewers. The intercepting sewer on the North of the Town will start with a 9-inch pipe from opposite the Lyari slaughter yard and pass the North end of Ledbetter Road, along Runchore Pooree Road and Mission Road, and will discharge by a 15-inch sewer into the South intercepting sewer at the junction of Bunder and Mission Roads with a fall of 3 feet per mile. The South intercepting sewer will start with a 12-inch pipe from a point opposite the Luckmeedass drain and will be 24 inches diameter at its junction with the North sewer at the end of Mission Road, and will be built of rubble masonry lined with cement. From this point of junction with the North intercepting sewer the South intercepting sewer will run along the Bunder Road and will be 27 inches in diameter,



' Press, 19 Lall Bazar Street, Calcutta

also of masonry with a fall of 3 feet per mile and continue of this diameter till it meets the main sewer from Camp at Government Garden Road. The depth of excavation at this point will be about 26 feet.

19. The intercepting sewer from Civil lines will be laid along the whole length of Victoria Street, commencing with a pipe 9 inches in diameter and ending at the junction of Bunder and Government Garden Roads with a pipe 18 inches diameter. The gradient here is 6 feet per mile. The junction of the Camp intercepting sewer with the Town intercepting sewer will be in a tumbling bay 25 feet deep from surface of ground. A detailed description of the various pipes and the mode of laying them will be given later on in this report.

20. From the point of junction of the two main sewers from Town and Camp the outfall sewer will be built of rubble masonry and lined with cement, its dimensions will be 2 feet 6 inches in width by 4 feet in height, with a gradient of 3 feet per mile, and will be built in a cutting averaging 28 feet in depth. The line to be followed from the junction at Government Garden Road will be past the Belooch Hospital, along the Government Garden Road and across the *maidan* to the corner of the lane leading to the House of H. H. Aga Alli Shah and along the lane to its junction with Lawrence Road. For the last 3,000 feet of this length, the culvert will have to be so enlarged as to form a reservoir sufficient to contain the night flow of sewage, as the pumps will only be worked during the day. A sectional area of 3 feet by 4 feet will, I think, be enough. This portion of the sewer will require to be specially provided with valves to prevent back flow and ventilation shafts for the escape of any sewer gas that may accumulate. At the end of the reservoir portion of the sewer, it will be necessary, on account of the depth of the excavation (31 feet) and the height of the subsoil water, to fix this as the site of the pumping station, where the sewage will be lifted to a height of 16 feet, and forced through a rising main on to the sewage farm, a height of 39 feet for a length of 7,800 feet. From this point the rising main will run in a straight line across the Lyari river to the sewage farm and will consist of a 30-inch cast-iron flanged pipe 1 inch thick. As the level of the starting point of the sewer at old Town is 53·29 and that of discharge at the lower invert 64·79 the total amount of fall in the sewers is 11-50 feet.

(*To be continued.*)

BUILDING CONSTRUCTION IN ASSAM.

In Upper Assam bungalows supported on posts, walled with *Ekra taties*, and roofed with grass, are called permanent buildings. Only lately brick work has been introduced for pillars or walls, and corrugated iron sheets for roof materials, and this in case of Government buildings or other private structures of extra superior strength and durability. But brick walling, brick arching, and terrace roofing have not had their recommendation in this part of the country. This is owing partly to the want of skilled manufacture of bricks and flat tiles and partly to the natural dread of the inhabitants of constant earthquakes, that have been observed to have cracked many a fine arch and shattered many a sound wall. The *Nahor* post with sufficient lead under ground, when well-joisted and strutted with the wall and roof, has been found the safest and strongest support for a building of this description. The earthquake may shake the structure, but no danger is apprehended from a crack or a tumbling-down of any portion of the building. Then comes the question of roof. Of course, with posts for support a flat terrace roof or any other kind of roof of heavy materials, such as bricks, tiles or stones, cannot be thought of; and even when the walls are made of bricks or the posts have given place to the more imperishable *pucca* pillars, the want of suitable materials for the flat roof, and above all, the dread of earthquake, have made the "Pent" roof unavoidable in Upper Assam. Timber structure, bamboo framing, over that a stretch of bamboo mats (locally called *dharree*) and a coat of grass six to nine inches thick, are all that compose the most permanent roof ordinarily. Teak shingles from Moulmein were tried in some grand Government buildings, but they ill-suited the climate of the Province. The pouring rains, and the almost scathing sun alternately work at them in such a way, as to warp them, crack them, and rot them in no time. Experience has shewn that as soon as the shingled-roof has seen, say, half a dozen monsoons of Upper Assam, no amount of patching or canvassing, caulking or tarring, will help to keep it water-tight. Besides, the item of expense alone is sufficient to prevent any large use of this material here. When, therefore, flat terrace, or any other brick or stone roof, is out of the question, grass thatching does not do, and shingle fails, corrugated iron sheet is the only roof material that should have the greatest recommendation with the Engineers of this Province.

Unlike those of other parts of India, the cities of Upper Assam present to the eye a very peculiarly monotonous view of long lines of Sheffield ridgings and vast expanses of B. W. G. corrugations. The major part of the population of the country still live in the most wretchedly built huts, not even worth mentioning. The minority having acquired a more refined taste have only lately commenced to build bungalows for dwelling-houses; and they occasionally use corrugated iron for the roof material. But in the cities and towns, where only it is natural that there should be permanent buildings in blocks and masses, that such a profuse and almost promiscuous use of corrugated roof is seen. These roofs, however, though infinitely superior here to all others mentioned before, and though perfectly water-tight and tidy, have often too much affection for the effects of weather. In winter they are icy cold, in the hot season they are quite unbearable. In the mid-summer day, when the tropical sun darts its perpendicular rays over the vast iron roofs of an Assam town, when the areas of such roofs generally measure more than the extent of its roads and alleys, the landscape presents the appearance of a mass of blazing reflections and the town itself seems to be little less than a burning furnace.

To mitigate the heat of corrugated roofs many ingenius designs have been made, and sometimes an inside ceiling of planks or mats and sometimes a coat of grass thatching on top of roof have been provided, but ever without complete success. The Engineering world of the present age seems to be pretty busy with the inventions of paper rails or straw beams, and it may not be out of place here to record our expectations soon to find corrugated paper as a fitting substitute for corrugated iron sheets. In a province like Assam such an invention will be of incalculable advantage. Those experts of Europe and America, whose skill and ingenuity have made paper equal and almost superior to iron or steel as regards its strength and imperishableness, and have rendered it fireproof and waterproof, so much so as to be safely used in engines and chimneys, in railway wheels and hulls of ships, will not, it is presumed, find it difficult to shape and to qualify it for the purpose of roof covering in place of corrugated iron sheets. The ordinary samples of paper wares, boxes and plates, appear to be quite impervious to rain or the sun and as hard and durable as iron, tin or timber; and that with better devices and greater skill, it will not prove equal to our demand it is impossible to believe. Let the proprietors of our Indian paper mills devote a little of their attention to this particular, and we are sure to find wonderfully good paper made articles to occupy the place of wooden planks or iron sheets. Paper will be lighter than both wood or iron, more easily workable, cheaper in value and infinitely more decent in appearance; and its disaffection for the influences of the weather will be its strongest recommendation in opposition to its sister materials.

Hari Nath Chakravarti.

NOTES FROM HOME.

(From our own Correspondent.)

MR. HUMPHREYS read a paper on "Class Mortality Statistics" before the Royal Statistical Society at their last ordinary meeting. The first part of the paper described the existing life tables, which throw light upon the varying rates of mortality in various social classes. It is almost impossible to condense the figures that are herein dealt with, but it may be summed up in saying that the effect of class influence upon the mortality statistics in each of the age periods is most striking. The author closed his paper with an appeal to medical officers of health and others for further investigation in the direction of Dr. Grimshaw's statistics and urged a stronger faith in the possibility of controlling the present wide range between the death-rate of the upper and the working classes.

The second volume of the proceedings of the Institution of Civil Engineers (Vol. 88) for the current session, has just been issued. It embraces, besides the three papers read at the meetings, nine other selected papers on various subjects, together with the usual valuable contingent of abstracts of papers in foreign transactions. In the obituary notices in this volume we find the name and record of Rear-Admiral Bedford Pinet who died last October.

During the past few weeks workmen have been actively engaged commencing the construction of the central station of the Birmingham Compressed Air Company, and in the course of the next two or three months operations will have so far advanced as to supply customers with this latest motive power to the extent at first of 6,000 indicated horse-power. The development of the scheme will be watched with great interest.

The Richmond Urban and the Richmond Rural Sanitary authorities have applied for a Provisional Order to form their two districts into a united district under the Public Health Act for sewerage purposes. It is proposed that the joint Board constituted from these combined districts shall have powers similar to those that were exercised by the now defunct Lower Thames Valley Sewerage Board. In the present case Mr. Mellish's scheme to cost about £100,000 has been accepted and has received the sanction of the Local Government Board.

For the contest in coupling waggons, which lately took place at the Forth Goods Station, Newcastle, and which I previously referred to, nineteen waggons were placed in a row with their couplings unattached. The time occupied by the winner in coupling and uncoupling these nineteen waggons being 1 minute and 26 seconds. The work was done with the coupling pole, which is an ash-pole 6 feet 9 inches long, as previously described.

Attention is now called to the present low price of copper; to point to the advantages that that metal possesses as a roofing material over zinc or lead. The *Building News* states that 16oz. sheet copper can now be supplied and laid at from *1s. 3d.* to *1s. 6d.* per foot super.

At the last meeting of the Institution of Civil Engineers four papers were read on the subject of obtaining water-supply from wells, namely; "Chalk-springs in the London Basin, by J. W. Grover; Borings in the Chalk at Bushey, Herts, by W. Fox; On a Borehole in Leicestershire, by T. S. Stooke; and The Wells and Borings of the Southampton Water Works, by William Matthews. The latter paper included a short account of the deep well on Southampton Common, bored between 1838 to 1851 to a depth of 1,317 feet, when it only yielded 130,000 gallons per day.

These papers will be discussed at the next meeting, and very valuable information bearing upon the large and rapidly increasing water-supply required for London is likely to follow the reading of these important papers.

MINING IN GREAT BRITAIN.

(From our own Correspondent.)

THE Royal Jubilee Exhibition of Newcastle-upon-Tyne originated by the North of England Institute of Mining Engineers will be opened on 11th May 1887. The development of our mining industries will be well represented by the collieries and engineering firms of the district.

A model coal mine will be provided for the instruction of those visitors who do not care to risk a descent into the bowels of the earth. The arrangement of the galleries will convey a correct idea of the modes of mining by the bord and pillar, long wall and other systems; and ventilation will be produced by means of a fan. The illusion will be perfected by the sides of the galleries being built with coal and stone. It will be lighted by fixed electric lamps.

The question of haulage will be illustrated by an exhibit showing most of the important systems of endless rope and chain haulage. The motor power will be supplied by the force of steam, compressed air, and electricity. A very compact form of mine locomotive, driven by compressed air, will be exhibited by the patentees, Messrs. Lishman and Young.

Altogether the exhibits of mining, metallurgical, and other appliances enable one to see that nothing has been omitted in order to ensure success.

The mine explosions on the Continent have again induced belief that they are the the consequence of the earthquakes. If issues of gases in mines are promoted by seismic disturbances of the earth's crust, it appears that observations of seismographs, placed in coal mines, would shew any increase of seismic activity, and would furnish warnings of the probable issues of gas. It may be that some time would necessarily elapse before the connection between seismic motions and issues of gas was satisfactorily established. But the rapidity with which discoveries have been made with regard to the motions of the atmosphere, lead us to believe that the supposed connection would furnish valuable results after a few years' observations.

Observations in Japan support the view that earth tremors are connected with barometric variations, or, in other words, earth waves are produced by air waves. These earth waves may consequently be used, as they travel more rapidly than air waves, to foretell variations of the barometer.

It has been often argued that there was a necessary connection between the pressure of the atmosphere and the issues of gas in mines. It would consequently appear that the true correlation exists not between the barometric height and the issue of gas, but between issues of gas and the seismic motions which precede changes of the pressure of the atmosphere.

A cargo of Kentucky cannel coal (1,700 tons) was shipped at New Orleans for Liverpool recently, where its quality ensured a sale at about 65*s* per ton. This cargo may be said to form an important item in the history of coal mining in Great Britain.

A boring at Dover, which has now reached a depth of 500 feet, is being prosecuted with the view of ascertaining whether the strata are conformable with those upon the French coast. The discovery of coal is another object of the boring, but none has yet been found.

A new form of coal screen has been invented by J. Karlick, of Bochum, in Germany. It consists of a pyramidal framework suspended by a ball and socket joint. The screen consists of two superimposed perforated plates with apertures of $\frac{1}{2}$ and $\frac{1}{6}$th inch respectively, which sort the coals into three sizes. The vibration of the screen is effected by an eccentric at the bottom. With 120 strokes per minute, it screens 250 tons of coal per 8 hours or 30 tons per hour.

Poetsch's method of sinking shafts through quicksands, by freezing, continues to afford successful results upon the Continent. A shaft was sunk in Prussia by this method for a depth of 90 feet in $7\frac{1}{2}$ months, at a cost of £2,500.

A large pumping engine has been erected at Bradley, near Bilston, by the South Staffordshire Mine Drainage Commissioners. The engine works two 27-inch plungers with 10 feet stroke, delivering 496 gallons of water per stroke from a depth of 380 feet. When running 7 strokes per minute this is equal to 5 millions gallons of water per 24 hours.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, May 14, 1887.

Mr. J. C. Wyatt, Executive Engineer, 4th grade, is granted an extension of one day to the privilege leave granted him in *Burma Gazette* Notification, dated the 14th March 1887. Mr. Wyatt reported his return to duty on the afternoon of the 6th instant and is posted temporarily to the Pegu Division.

With reference to *Burma Gazette* Notification, dated the 8th October 1886, the Thayetmyo Sub-Division of the Tharrawaddy Division, will be re-constituted an independent Public Works Division, with effect from the 1st June 1887, and placed in executive charge of Mr. J. C. Wyatt, Executive Engineer, 4th grade.

Mr. G. Deuchars, Assistant Engineer, 1st grade, Burma State Railway (Toungoo-Mandalay Extension), has passed the Lower Standard examination in the Hindustani language.

Madras, May 17, 1887.

The following transfers are ordered :—

Mr. C. H. T. Norfor, Executive Engineer, 3rd grade, from No. III. Party, Tank Maintenance Scheme, Kurnool Division, to the IV. Circle, Coimbatore Division, for charge of No. IV. Party, Tank Maintenance Scheme. To join on return from furlough.

Rai Bahadur S. Subharaya Chariyar, B.C.E., Executive Engineer, 4th grade, from No. IV. Party, Tank Maintenance Scheme, Coimbatore Division, to the III. Circle, Kurnool Division, for charge of No. III. Party, Tank Maintenance Scheme. To join at the public expense on relief by Captain O. V. Boddy, R.E.

Punjab, May 19, 1887.

Mr. T. R. J. Ward, Assistant Engineer, 1st grade, 5th Division, Sirhind Canal, is allowed 6 months' leave without allowance.

Bombay, May 19, 1887.

Captain W. J. Lister, R.E., is appointed to act as Executive Engineer, Aden, during the absence of Lieutenant-Colonel J. D. Cruickshank, R.E., on privilege leave, *vice* Captain W. W. Robinson, R.E., recalled to Bombay for special duty.

H. E. the Governer in Council is pleased to make the following appointments :—

Mr. J. H. E. Hart, Chief Engineer, 2nd class, to act as Superintending Engineer, Central Division, in addition to his duties as Chief Engineer for Irrigation, pending further orders.

Colonel A. T. Mander, R.E., to act as Superintending Engineer, Northern Division, *vice* Colonel W. M. Ducat, R.E., as a temporary measure.

Mr. T. D. Little, M. Inst. C.E., on return from furlough, is appointed Executive Engineer, Khandesh.

Mr. W. E. Pedley, Assistant Engineer, 1st grade, is appointed to act as Executive Engineer, Eastern Nara Canals, during the absence of Mr. J. A. Coghlan, on privilege leave.

N.-W. P. and Oudh, May 21, 1887.

Irrigation Branch.

Babu Bidhu Bhusan Biswas, Assistant Engineer, 1st grade, is, on return from furlough, posted to the 2nd Circle, Irrigation Works.

Mr. M. Nethersole, Executive Engineer, 4th grade, temporary rank, Traffic Manager, Ganges Canal, is temporarily attached to the Meerut Division, Ganges Canal, in addition to his other duties.

India, May 21, 1887.

Mr. A. B. Sampson, B.A., Under-Secretary to the Government of India, Public Works Department, is permitted to retire from the service of Government, with effect from the 14th May 1887.

With reference to Public Works Department Notification, dated 17th May 1887, Mr. G. H. D. Walker, B.A., Examiner, 4th class, 1st grade, Officiating Under-Secretary to the Government of India, Public Works Department, is confirmed in that appointment, with effect from the 14th May 1887.

The Governor-General in Council is pleased to order the abolition of the office of Consulting Engineer to the Government of India for Guaranteed Railways, Lahore, and the constitution of an Office designated Consulting Engineer to the Government of India for Railways, Central Division.

The Government control of the Bengal-Nagpore Railway will be exercised through the Consulting Engineer to the Government of India for Railways, Central Division.

In supersession of Public Works Department Notification, dated the 20th October 1885, which is hereby cancelled, the Government control of the Indian Midland Railway will be exercised through the Consulting Engineer to the Government of India for Railways, Central Division.

The Governor-General in Council is pleased to invest the Director of the North-Western Railway with the powers of a Consulting Engineer for Railways in respect to the Railways comprising the North-Western Railway System.

With reference to Notification of this date, the Governor-General in Council is pleased to appoint the Director of the North-Western Railway to be an Inspecting Officer under Section 5A of Act IV. of 1879, as amended by Act IV. of 1883, in respect to the Railways comprising the North-Western Railway System.

The services of Captain R. Gardiner, R.E., 1st class, 3rd grade, Superior Revenue Establishment of State Railways, are placed at the disposal of the Government of Bombay for employment as Manager and Engineer-in-Chief of the Bhavnagar-Gondal Railway

Mr. J. Ramsay, Executive Engineer, 1st grade, State Railways, and Engineer-in-Chief, Sind-Sagar State Railway, is appointed to officiate as Under-Secretary to the Government of India, Public Works Department, Railway Branch, *vice* Captain R. Gardiner, R.E.

The Governor-General in Council is pleased to order the following appointment :—

Colonel W. A. J. Wallace, R.E., Officiating Consulting Engineer to the Government of India for Guaranteed Railways, Lahore, to be Director of the North-Western Railway, *vice* Lieutenant-Colonel L. Conway-Gordon, C.I.E., R.E.

Pandit Matadin Sukul, Apprentice Engineer, Assam, is promoted to Assistant Engineer, 3rd grade, with effect from the 14th May 1887.

Mr. W. S. Haig, sub. *pro tem.*, Executive Engineer, 4th grade, is temporarily transferred to the Accounts Branch, in the temporary rank of Deputy Examiner, 1st grade, and is posted to the Office of the Examiner of Accounts, North-Western Railway.

Major F. V. Corbett, R.E., Superintending Engineer, 3rd class, temporary rank, North-Western Provinces and Oudh, reverted to his substantive rank of Executive Engineer, 1st grade, with effect from the afternoon of the 6th January 1887.

Major W. Shepherd, R.E., Superintending Engineer, 3rd class, temporary rank, State Railways, is appointed Consulting Engineer to the Government of India for Railways, Central Division, *vice* Colonel W. A. J. Wallace, R.E.

Director-General of Railways.

Mr. H. Groves, Executive Engineer, 2nd grade, is, on return from three months' privilege leave, posted to the Tounghoo-Mandalay Extension of the Burma State Railway.

Mr. S. DeBrath, Executive Engineer, 4th grade, temporary rank, is transferred, in the interests of the public service, from the North-Western Railway to the Kwaja-Amran Railway Survey.

Central Provinces, May 21, 1887.

With reference to Notification, dated the 7th ultimo, Mr. C. O. Leefe, Executive Engineer, surrendered, and Captain J. C. Addison, R.E., assumed, charge of the Hoshangabad Division on the afternoon of the 11th current.

Assam, May 21, 1887.

Furlough for six months is granted to Mr. E. J. Moore, Executive Engineer, 1st grade, sub. *pro tem.*, Bengal-Assam State Railway, with effect from the date he avails himself of the same. Tne usual subsidiary leave admissible under section 64 of the above Code is also granted, with effect from 17th May 1887.

Privilege leave for one month is granted to Mr. G. W. Winckler, Executive Engineer, 3rd grade, with effect from such date as he may avail himself of the same.

Bengal, May 25, 1887.

Establishment—General.

Mr. H. O. Walling, Assistant Engineer, passed the Lower Standard Examination in Hindustani on the 3rd January 1887 and the Departmental Standard Examination on the 7th February 1887.

Establishment—Irrigation.

Mr. G. J. R. Leeson, Executive Engineer, is temporarily attached to the office of the Superintending Engineer, South-Western Circle, from the forenoon of the 17th instant, *vice* Mr. J. F. Williamson, transferred to the charge of the Nuddea Rivers Division.

Notices.

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CONTENTS.

Obituary.

CROOK.—At Calcutta, on 22nd May, Thomas Crook, of Oldham, Manager of the Garden Reach Spinning and Manufacturing Mill, aged 53.

INDIAN ENGINEERING.

SATURDAY, JUNE 4, 1887.

A WAIL FROM MADRAS.

WE have before us copy of a memorial submitted by the passed students of the Madras Civil Engineering College, to the Governor of that Presidency laying some of their grievances before him for redress. We are sorry to observe that the type of lugubrious petitions is now the order of the day all over the country, and the slightest provocation is sufficient to send out a body of men, who are laboring under some disabilities, real or fancied, ready to give vent to their sorrow at the foot of the throne of *ma bap.*

We have, for the benefit of the rising generation, over and over in our columns, advocated the cause of self-help, and the strength it engenders in the struggle for existence. The benefits are so palpable that it is a wonder to us they should not be accepted as an axiom. To cry and wring one's hands in despair, is not a happy state, and is not actually what is required in the young men that annually leave their Alma Mater to prepare for the battle of life. To our thinking it should, by every means, be deprecated. For what purpose have we been endowed with a free will and force of character, if not to overcome difficulties, which, at first sight, appear insurmountable, but which melt like snow before the rising sun, when met by an invincible sturdiness of character that owns no defeat. Where would America and Australia have been, if, instead of putting their shoulders to the wheel, like men resolved to do or die, the first emigrants sat down on the beach, and wept like children, bewailing their hard fate at being thrown in the midst of an inhospitable community ?

Those who have watched the career of this Journal will have found out that we have ever set our face against injustice in any shape, irrespective of condition in life, whether in high or low places, whether the object of it has been a Secretary to the Government of India, or an Overseer in the Department, and shall continue to follow in this track so long as we have a voice in the matter. But when we find that the grievance complained of is purely imaginary, we hope it will not be taken amiss if we offer some advice on the occasion. It must be distinctly understood that the policy of Government, openly avowed, is to sow broad-cast the seeds of education—technical or otherwise—without binding itself to provide employment for those who avail themselves of it.

This is a fact, we regret to observe, completely lost sight of in the periodical memorials to the authorities, and in an impartial discussion of the question. In the first place it would be simply impossible to provide every one of the alumni of our Colleges with a post in the public service: secondly, it would hamper private enterprise and leave it to suit itself as best it may: and lastly, it would be striking at the root of that invaluable quality

of self-help, which it is the direct object of our educational institutions to foster.

Now let us examine the grievances of the students of the Madras Civil Engineering College, and see how far they are justified in their contention. It is said the College was established in 1859, and in 1862 a First Department was added with the express object of training young men for the post of Assistant Engineers in the Department of Public Works: that one S. Subarayar Chariar held the first place in the first batch of students that passed from the College in 1863; he was not given the post of Assistant Engineer, but only that of Supervisor, whereas four European students who passed in subsequent years got the much coveted posts of Assistant Engineers, thereby superseding Chariar, who is now, however, an Executive Engineer, fourth grade. On the admission of the memorialists themselves, one of the four Europeans is dead, one is an Executive Engineer, third grade, and two are not now in the Department. What do these facts show? That even if the selections were faulty the grievance, if any, has practically ceased to exist.

The memorialists then go on to say that since 1881, the service has been more largely recruited by the passed students of the local Engineering College. To particularize details, since 1881 a large number of young men have been taken on in the Department, both as Assistant Engineers, Supervisors, Overseers, and Apprentice Overseers, and, what is more to our purpose, a good number of them were drafted into the South Indian Railways, to the District Boards and the Mysore P. W. D. Could anything be more encouraging than such results? Then, again, some of them were sent to Burmah and others to the Native States, which go conclusively to prove that the services of these men are utilised to a good extent.

The next contention is, that in the Upper Subordinate Grade, about seventy-five per cent. of the nominees were passed military students, who, according to the memorialists should not have been appointed, as it is "contrary to the recommendation of the Public Works Commission and to the detriment of natives whose claims are in every way superior, and who form a very large class compared with the few military students." We do not know on what facts the recommendation of the Commission is based, but of this we feel confident that such a large percentage would never have been employed unless the necessity for it existed. We must also enter our protest against any insinuation as to the superior claims of natives to those of military students.

Appended to the memorial is a list of students who, having failed to obtain their just rights, in that have been driven to seek employment in other Presidencies and Native States, and sixteen of these are mentioned by the memorialists, who have committed a grave error in citing their case as an injustice on the part of Government in failing to provide employment for the deserving. It is a decided proof, if any were wanting, that there are among them independent, adventurous spirits who have broken through the trammels of red-tape and have gone into the world to carve a name and fame for themselves, independent of any help from patrons and friends, and such a determination should be encouraged rather than stifled.

In regard to the gratuitous attack on Cooper's Hill College and its alumni, Indian students would do well to bear in mind that a professional education in that institution costs between £1,000 and £1,500 for the whole course, and that only a fraction of the passed students are sent out to India, by far the larger number either find employment at Home, or go to other countries in the world, where their sphere of usefulness is extended and where they are not tied down by service rules.

THE KUMAON IRON WORKS.

A good story will bear repetition, and the time is opportune when the circumstances connected with the failure of the Kumaon Iron Works may once more be brought before the public. They serve to point a moral, although there is wanting the sensational element to adorn a tale. Notwithstanding the anxious professions of Government to develop the material resources of the country, and to encourage reproductive industries, it is a notable fact that the attempts in such directions are generally marked by absolute miscarriage. Everything is done on a profuse scale out of all proportion to the nature of the scheme, as the sequel will show.

So far back as 1851 a very minute survey of the Kumaon Bhabur was made by Lieutenants Vanrenen and Burgess, but they failed to detect anything unusual in the rocks along the beds of which roads had been cut and it was reserved for Captain Herbert to notice their ferrugenous appearance. But it remained for Colonel Drummond to make the discovery of the valuable mineral in which the locality abounds. In the beginning of 1855 a party of three miners under Mr. Henwood arrived in India to work the ores. It appears that for some time no satisfactory progress was made. Mr. Sowerby, C.E., of the East India Railway Service, drew up an elaborate report on the subject, in a cool and quiet retreat at Nani Tâl, while the surrounding country was in the throes of the Sepoy Mutiny. On his recommendation the concern passed into the hands of a company in 1860. In the year following, a Swedish Manager, Mr. Julius Ramsay, was appointed, under whose initiative, in 1863, there resulted an uninterrupted working of the furnaces in two separate places for 4½ and 4 months respectively. Just as matters began to wear a hopeful appearance it was found that the capital of the company had run low, without any prospect of increasing, and the shareholders had no other alternative but to close the work *pro tem.*, in hopes of favorable times returning to resume operations.

The expected reaction, however, did not set in, and after twelve years of inactivity, that is, in 1875, the Government of the N.-W. P. took the lease and entered into possession of the property. Mr. Angus Campbell, Superintendent of the Roorkee Work-shops, being placed in charge. On examination he found that ore from Ramghur was necessary to mix with that of Dechouree, and it would pay better to carry down the Ramghur ore, even at a high cost,

than use the latter ore alone. It was, therefore, proposed to construct a cart-road, but financial difficulties stood in the way of its accomplishment. Nearly the whole of the sum of Rs. 50,000 allotted for the work during 1876 was absorbed in paltry items, leaving a balance of Rs. 1,500 only, which was insufficient for the purpose of establishing communication between the two places. Instead of wasting Rs. 5,000 in erecting a bridge and cart-road, between Dechouree works and mines, a distance of a mile, if the amount were expended in joining Dechouree and Ramghur by a path 6 or 7 feet wide, a serious impediment in the project would have been removed. These difficulties were, however, temporarily tided over; but when it came to making the furnaces, for want of proper supervision, gas explosions were of common occurrence. After a four days' trial with a mixture of Ramghur and Dechouree ore, no iron resulted and the furnaces were emptied out. Thorough incompetence was at the root of the disaster. One special item of useless expenditure was an outlay of Rs. 2,000 in chemical apparatus and experiments for analysing the ores, when years before it was settled by scientists what were the relative properties and value of the ores.

Then followed a change in the management of the concern. The services of a professional furnace-keeper, in the person of a Frenchman, were secured, but with no happy results. A series of experiments made from April to June 1887 ended in gas explosions and ultimate collapse, for a sufficient reason, that not a single individual connected with the works had the slightest practical knowledge of the subject. Persons, as ignorant of scientific attainments as a new-born babe, were taken on for no qualifications whatever, but that they had influential friends in certain quarters, and 'Dowb' must of course be taken care of. Every precaution was adopted to sedulously keep out men who had technical training, which could alone ensure success. But that element being wanting, matters went from bad to worse till they culminated in a conspicuous failure. A flaring report was made of the circumstances attending these mishaps, with a dash of technicality about them, and as the department to which it was addressed knew little or nothing of iron manufacture, the representations were accepted as gospel truths.

RAILWAY FACING POINTS AND SIGNALS.

Facing points are as a rule objectionable where it is possible to avoid them, but where they are unavoidable, the arrangement must of necessity be so perfect as to be least liable to derangement and preclude them from becoming a source of danger. Railway points and their gearing have undergone many improvements—all having for their object the perfect security of the points and aversion of accidents, which mostly arise from the imperfect working of the former. Being fully aware from the experience of the past half century that points and signals, however carefully attended, have in many instances signally failed either from neglect on the part of the man in charge of them or other causes, mechanical, climatic, and intentional, Railway Engineers have striven hard to remedy a defect which has led to much loss to person and property. A variety of systems have been devised, introduced, and tried, but with qualified success. We are told by Mr. Fahie, C.E., in an excellent paper on this subject, which he read before the Institution of Civil Engineers of Ireland, and of which he has favored us with a copy, that although there are a few systems in use at present which appear to work fairly well, they all are open to objection on the score of the connections, cranks, &c., being not altogether reliable—*first*, because of the expansion and contraction of the point rod; *secondly* because of the liability of the point rod to give way or buckle up; and *thirdly*, because there is the danger of the cranks being strained owing to obstruction getting between the switch and the stock rail or the connections being tampered with by malicious persons—against which under the existing arrangements there is no security.

Mr. Fahie has bestowed much time and labor in the study of the subject, the importance of which cannot be gainsaid, and the conclusion he has arrived at after careful consideration of the advantages and disadvantages offered by the various systems in vogue on the various Railways at Home and abroad, that the only system which combines in its working the application of a contrivance introduced by Mr. William Henry Elliot to prevent the straining of cranks by which the points are moved and hold them rigidly after they are moved, is that invented by Messrs. Payne and Jackaway. Under this system all the disadvantages, dangers and shortcomings, in connection with the working and locking of facing points as well as safety bar and signals, are very ingeniously overcome in a satisfactory manner which seems to fulfil admirably all necessary requirements. The system concisely described consists of a bed plate between the switches and connected by two tiebars to the chairs. On this plate a disk is arranged to rotate on a central point and is provided with two eccentric slots in which work two pins fixed by a stretcher bar joining the switches together. The eccentric slots are so formed that upon the disk being rotated the pins move alternately towards the centre, and in doing so open or close the switches as may be required. The advantages secured by this motor are minimum resistance offered to the movement of points; firmness and security of the same; non-requirement of the intermediate connections; which under various old systems are often the source of great danger; and the compensation secured by the eccentric slots for climatic influence leading to contraction and expansion. Further, the slot arrangement renders the movement of the points impossible.

We have not the space to describe the operation of the switches arrayed under this system and give further details of the various parts and their functions, for which we would refer our readers to the paper from which we have derived our information, as the various features of the system are so fully described therein as to require no further elucidation or addition from us. We are told that this system has given satisfaction wherever it has been introduced, and it is approved of by General Hutchison, Board of Trade Inspector, and many Railway Engineers.

Notes and Comments.

BENGAL-NAGPUR RAILWAY.—We are informed that "Construction" work will commence in October next; and, in the meanwhile, the Staff will be usefully employed in making the necessary preparations for a good start.

RANGOON DRAINAGE SCHEME.—A Correspondent writes:—"I trust the loan necessary to carry out Shone's Hydro-Pneumatic project will soon be closed, when all India will come to see results and follow our example.

THE NEW INDIAN PORTLAND CEMENT Co.—We are afraid that there is but little prospect for the present of resuscitating this concern. The proposals for starting afresh have all ended in nothing, and circumstances generally point to a long standstill.

THE RANGOON CATHEDRAL.—Messrs. Burn and Co. are now executing at their Raniganj Potteries the Terra-cotta mouldings for the Rangoon Cathedral. The "order" is from Messrs. Robinson and Co., the Contractors, and includes Finials, Parapets, Bosses, Panels, &c., after the style of the Financial Buildings at Calcutta.

THE BENGAL-NAGPUR RAILWAY.—We are informed that the adoption of the Asansol junction by the B.-N. R. is favored by the Calcutta Chamber of Commerce, and that the immense mineral traffic between Barakar and Sitarampur and Sitarampur and Asansol on the E. I. R. has disposed the authorities of the latter line to take the same view of the question.

RANIGANJ TILES.—The demand for the new pattern of roofing tile manufactured at the Raniganj Potteries is steadily increasing, and Messrs. Burn and Co. have already had to provide for the expansion of their business, which is largely attributed to Government patronage. The advantages claimed for this roof covering are "lightness and simplicity"—obtained with due regard to other essentials.

SAFETY AND ECONOMY IN THE WORKING OF RAILWAY POINTS.—The system of interlocking points recently introduced at some of the principal stations on the E. I. R. has, we are informed, fulfilled the most sanguine expectations, having effected a large saving—about 50%—over the common method hitherto in use, and reduced the possibility of danger arising from this source to a minimum. It may now be hoped that the system will be introduced throughout this and other Railways in the country.

THE STORM IN THE BAY OF BENGAL.—The recent cyclone turned out to be a much more violent one than was judged to be the case from the land observations. Near its centre the weather was excessively stormy, the winds were exceedingly fierce, and the sea was extremely rough. A wind velocity of no less than 69 miles an hour was registered at False Point, and one of 67 miles an hour at Saugor Island; and it must be remembered that these figures only represent the average velocity in the hour, and do not in any way take into account the heavy gusts which would be of far greater force.

PAHANG MINING COMPANY, LIMITED.—This Company proposes to acquire mining and other properties in the territories of the Sultan of Pahang, or elsewhere in the Malay Peninsula or Archipelago, and particularly to purchase a concession or grant of land from the Sultan, upon terms of an agreement with William Fraser. It was registered on the 27th April, with a capital of £200,000, in £1 shares. The number of Directors is not to be less than three nor more than seven; the subscribers are to appoint the first, and act *ad interim*; qualification, 500 shares; remuneration, £200 per annum to the Chairman, and £150 per annum to each Director.

PATENTS IN AUSTRALIA.—The first steps towards the amendment of the law as to patents have been taken in N. S. Wales, where there have been two chief causes of dissatisfaction as regards the existing Patent Law of the Colony—the one, the considerable expense attendant upon the process of obtaining letters patent, which is considered a discouragement to needy or struggling investors; the other, the fact that a large portion of the money paid goes into the pockets of officials. It appears that the intention of the Coloniel Government is to reduce the cost of obtaining a patent (so far as official charges are concerned) to £5, and to place the management of the business in the hands of a salaried officer, to be called the Examiner of Patents.

MERIT *VERSUS* SENIORITY.—The question of promotion by priority or preferment is discussed in an American journal, and the conclusion arrived at is, that there are evils and abuses in the system of advancement by "Merit" as those which inhere in that of promotion by "Seniority." In Engineering, like other professions, *merit* is the only road to distinction; and the original framers of the Indian P. W. Code in their wisdom decided that as regards the Department, *seniority* would only be a claim, but *merit* should be the guiding rule, for promotion. The experience of the operation of this rule has been found to show that it has not been the means of promoting the deserving or a safeguard against unjust discrimination.

QUETTA NEWS.—Mr. O'Callaghan has found a very practical line for the railway across the Khojak estimated to cost about half the amount previously laid down. There will be a long tunnel and some miles of the Abt railway, otherwise the line presents no extraordinary features.—Rumours are rife regarding the movements of the Ghilzais, but little reliance can be placed on them. About a month ago it was stated that two months would see us on our way to Kandahar, but things seem as quiet as ever. Works have stopped being pushed on with the fever haste that usually prevails and the consequence is that labor is falling in price. The advent of the railway is making itself felt in the price of food and other commodities gradually increasing.—The Military road to the Pishin is now on a fair way to completion. Steam rollers have been procured to consolidate the metal. Water for this will always be the difficulty in a country so destitute of the necessity as this is.

THE PAMBAN PASS.—The Port Officer, Madras, reports that the Pass is clear, but the shoal below having accumulated, dredging seems to be very necessary there. In the proposed agreement between the Company to be formed for cutting the canal and the Secretary of State, it is especially provided that the Pamban Pass shall not be interfered with, and as the canal cannot be available for some years, even if country craft will ever use it, it seems very desirable that a dredger should be obtained and set to work as early as possible. He adds that speculation on the prospects of the canal seems unnecessary; but after examining the ground on the proposed line of the canal and studying the charts, the conclusion arrived at was that the canal itself with immediate approaches is feasible if sufficient money is spent, but that the real difficulty will be found on the shoals lying between Point Calimere and the island of Ceylon, through which it seems

almost impracticable to keep open a passage of sufficient depth to enable large vessels to navigate.

THE MADRAS TRAMWAY.—Messrs. Wilson and Company, of Madras, undeterred by the previous failure of the tramway in Madras, have made definite proposals to the local Municipality for the construction and maintenance of a tramway in the city. The Tramway Committee have accepted nearly all Messrs. Wilson and Company's proposals, some of which are (1) that the contractor be at liberty to use the tramway for the term of 21 years, or such further period as the agreement may remain in force; (2) gas might be added as a motive power; (3) the buildings, &c., will be the private property of the Company erected upon their own land, and subject to such general bye-laws of the Commissioners as affect them in common with other buildings, &c., in the city; (4) the lines will be of metre gauge; (5) the Commissioners to undertake not to authorise any lines which may compete or interfere with the traffic of the conceded lines. Messrs. Weir and Co. were the last who tendered for the construction and maintenance of a tramway in Madras; but their tender was finally rejected.

THE MADRAS HARBOUR.—We much regret to find that the illustrations to the series of articles on the Madras Harbour works have been appearing somewhat out of place. The illustrations were all ready sometime ago, whereas the articles have been sent to us from a distance, and the articles and illustrations have somehow been wrongly sorted. Plates V. and VI. have thus appeared prematurely and in our issue of 7th May the former was incorrectly referred to as containing Mr. Beardmore's sections showing the damage, whereas these had been given in Plate IV. with a previous issue. Again, the article in our issue of 21st ultimo described Mr. Parkes' proposals for restoration made in 1882 shortly after the destruction of the Harbour, for which no drawing is available except the cross sections which are incorporated in the letter press: unfortunately Plate VI. was stitched up with that issue, but not referred to in it,—though it shows the final designs for restoration made by Mr. Parkes in 1884, in modification of those of the Home Committee, given in Plate V

ANOTHER VIEW OF JAPAN.—An elaborate report upon Japan published by Mr. Kreitner, the Austrian Consul at Yokohama, rather modifies English preconceptions of that empire. He says the earthquakes destroy a city every seven years, and that, moreover, the periods of volcanic activity, during which Fusiyama destroys everything in its neighbourhood, is again approaching. Of the 3,100 islands comprising the kingdom, the vast majority are of volcanic origin: and many of the more northern, including the great island of Yesso, are practically incapable of culture. There is plenty of coal and petroleum, but the mines of other minerals are State monopolies, and are badly worked, Japan, which used to export gold, now importing it. Mr. Kreitner speaks highly of the vegetable resources of Southern Japan; but he does not regard it as the paradise which it appears to men fascinated by its peculiar arts. He confirms the story that the Japanese Trade Guilds succeed in keeping the secret of making their steel sword-blades, of manufacturing the best lacquer, and of cultivating the wax tree, a pursuit requiring extreme care.

THE SINGARENI COALFIELD.—Mr. T. W. H. Hughes, Deputy Superintendent of the Geological Survey of India, states that the Singareni coal measures occupy a band of ground eight miles in length and one-and-a-half to two in breadth, and consist of four seams, aggregating a maximum thickness of 59 feet. Taking the lowest computation he estimates that at least 94 million tons of coal are available within 300 feet of the surface. The greater portion is a dull, hard coal, and is defined to be an excellent steam coal, capable of standing weathering and transport, being compact in texture and not splitting and wasting to dust. The remainder is bituminous and a good smithy coal, capable of being converted into good coke, and possibly would yield gas for illuminating purposes. Temporary arrangements have been made for extracting the coal. All necessary machinery has been ordered. No difficulty is anticipated in the supply of labour. In the vicinity of the coalfield there is a vast quantity of magnetic and hæmatitic iron ore, limestone rock and forest. Mr. Hughes concludes:—"All the circumstances and conditions of the Singareni field seem to me to indicate that there is a notable future in store for it." Time will tell.

FRONTIER RAILWAY ACCIDENTS.—Our Correspondent writes:—On the 7th May a goods train on the Bolan Railway consisting of 3 engines and a load of 36 wagons parted at Bibiecani Tanks owing to a coupling breaking in the act of stopping the train to water the second engine. The detatched portion of the train consisting of 31 vehicles including 2 brakes got away and soon got up a high speed due to a strong breeze and the grade of 1 in 50. The brakes were not applied till too late to be of any use. The train ran 11 miles increasing in speed till something over 60 miles an hour is calculated to have been reached. It went at this speed up the Kirta catch siding, which is on a curve of 600 feet radius, and was there derailed. The smash was complete. The only person on the detached portion of the train was the Guard and he was killed. I hear no one is to blame for this accident. Another accident took place on the 10th May in the Chupper rift Tunnel on the S. P. line Two wagons got away from Mangi Station and were there derailed. Three men were killed. The speed the wagons attained here was again very high, and it is certain that owing to the sharp curves there are on the lines a proper system of brakes is required.

THE UNCOVENANTED SERVICE.—The Annual Report of the Anglo-Indian Defence Association says that the Public Service Commission may serve one good purpose, if it bring prominently before the Government and the public the folly of attempting to carry out an administration on essentially English principles without the assistance of Englishmen in all branches of the Service. The Government which set out with the cry of impartiality proceeded so far in the direction of partiality to the Natives that, in 1882, the Roorkee resolution proclaimed a policy of injustice to the European community, and endeavoured to reduce to practice the principle enunciated by Sir E. Baring in the Budget speech of that year that Europeans and Eurasians were to be gradually eliminated from the Uncovenanted Service. Such a statement loses sight of the essential conditions of British administration in India. It is unjust and cruel, since it creates hopes and aspirations which no Government could possibly satisfy, and gives rise to the fallacious but dangerous doctrine that an English Government of India is hampered in its endeavours to be just to the Natives by an English community whose interests are opposed to those of the Natives.

Current News.

MR. WYNNE, the Chief Engineer of the Nagpur-Bengal Railway, is also Agent for the Company.

ENGLISH Engineers are engaged in strongly fortifying Herat, so as to enable it to stand a siege of sixty to ninety days.

NEWS from Persia says that the Russians are extending their railway in a southerly direction towards the province of Herat.

A SUM of Rs. 2,85,000 has been budgetted, and passed for improvements to the Fulta Battery on the Hooghly, during the current year.

SERIOUS sanitary defects have been discovered in some lately erected Government offices at Simla, and a committee of enquiry has been appointed *re* same.

MR. WYNNE, Engineer-in-Chief of the Bengal-Nagpur Railway, goes at once to Simla to confer with the Government regarding the working of that line.

LIEUTENANT R. F. ALLEN, R.E., has taken over charge of the Fort William Division, Military Works, from Captain J. Day, R.E., proceeded on leave of absence.

MR. G. K. WINTER, Telegraph Engineer of the Madras Railway Company, having invented electric Starting Semaphores for the starting of trains, his system has been adopted on that Railway.

THE last act of the Guicowar before leaving Baroda for England was to lay the foundation stone of the new market, which he proposes to build at a cost of Rs. 3,50,000, in memory of his late wife.

THE Madras Government regret to find that the Harbour Trust Board have not found means to effect greater economies in the cost of management. They leave the matter in the hands of the new Board.

A CORRESPONDENT telegraphs: "Madras will probably have a tramway in the leading thoroughfares ere long, as some London capitalists have, through a leading local firm, made proposals which are likely to be accepted."

MR. P. DANGERFIELD has been appointed Deputy Manager of the Indian Midland Railway. Colonel Wallace, who has been lately appointed Manager of the North-Western Railway, shortly, probably, takes three months' leave.

MR. A. R. COLQUHOUN, Deputy Commissioner, Sagang, Burma, and well known for his travels, has arrived in Calcutta. Mr. Colquhoun, we regret to hear, is suffering from fever and ague. and has been compelled to take six months' leave to England.

THE *Statesman* asserts that no less than five thousand men have struck work at the Jamalpore workshops of the East Indian Railway on account of certain rules that were promulgated on the 24th March, that have operated with much severity upon the labourers.

A TELEGRAM has been received from London, directing all further work in connection with the present Eastern opening of the Madras Harbour to be stopped, till such time as the decision of the authorities in England, with regard to the proposed North-East opening is known.

THERE have been several serious accidents on the Bolan and Sind-Pishin State Railways within the past three months, and it was time that the Railway authorities took some notice of this, especially when the greater number of them have proved fatal to one or two parties on each occasion.

PROFESSORS ELIOT and Pedler, of the Presidency College, Calcutta, have prepared a joint note, in which the necessity of the extension of superior education in Bengal is fully stated and a feasible plan for changing the constitution and working of the institution so as to convert it into a teaching University is laid out.

THE question of reducing the large amount of capital locked up in store in the railways in the Madras Presidency is now receiving the serious attention of Government, who, to remedy this state of things, have directed that the surplus stock of stores be reduced annually by five per cent., and that the stock be limited to about a two years' supply in all cases.

THE Engineer of the Karachi Municipality has submitted estimates amounting to Rs. 38,010 for paving with wood blocks the road between the Custom House and the junction of the McLeod and Bunder Roads. If sanctioned, Karachi will, we believe, be the first Indian town to introduce wooden pavements.

THE Karachi Chamber of Commerce have addressed the Punjab Government upon the need for improved railway communication between that port and the Sutlej district, and they announce that they are preparing to reopen the question with all the influence they can bring to bear on it locally and in England, and they count upon the hearty support of the Punjab Government.

COLONEL HOLLAND, of the Indo-European Telegraph Company, recently said that if the management of the Indian Government lines were equal to that of the Company's, a message from India should arrive in England in about 40 to 41 minutes, instead of, on an average, upwards of two hours, as was the case at present, and that this was a matter which the Government of India ought certainly to be able to remedy.

IT is refreshing, says the *Rangoon Times*, to hear the British Government repudiating the policy of State monopolies and expressing their abhorrence of such restriction on trade. Here is a list of the monopolies they hold in Burma:—Opium, Liquor, India-rubber, Teak, Rubies, Fisheries, Ferries, and Railways. Of course it was quite right to overthrow King Theebaw, because he proposed to sell *his* monopoly of railways and banking to a French company:—quite right, but hardly consistent.

A PATH has always existed whereby India could be easily connected with Burma. The Yomadoung range of hills becomes thinner and thinner till it discontinues altogether, skirting a plateau which could be easily crossed by a line from Silchar, the distance being a little less than that of the line from Rangoon to Prome. Thence it may be continued through the valley of the Nankathe and Kyendwen till it reaches the valley of the Irrawaddy at some point between Sagain and Pagan, which would be a distance of another Prome-Rangoon road; so that by constructing a line twice as long as that from Rangoon to Prome, Mandalay could be joined to Silchar.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

ANOTHER ANOMALY.

SIR,—The question of Government competition with private traders was discussed dry when the E. I. R. collieries entered the open market with the private Coal Companies of Bengal. Now happily this scandal has ceased, but the agitation in connection therewith drew my attention to another anomaly.

I found from the discussion that appeared in the public Press on the matter, that while the E. I. R. collieries were solely maintained or kept up for the benefit of the Locomotive Department of the line, and while *Mechanical* Engineering played an important part in their working, the coal-getting operations were entirely entrusted to the Way and Works Branch of the Railway and that the Locomotive Department had nothing whatever to do with them than to accept and use the mineral.

It has, therefore, occurred to me that, considering the extensive machinery and plant to be looked after at the collieries and the use to which the "output" is applied, the collieries might with advantage be brought under the control of the Locomotive Branch of the line.

ECONOMIST.

CONCRETE.

SIR,—Your correspondent "B," writing on "Concrete" in your issue of 21st May, appears to be a little behind the times when he says "Such a thing as a concrete-built wall does not I suppose exist in India." He is evidently unaware that the whole of the Secretariat Buildings in Simla are built of concrete, from founds to the top of the chimney pots, as even the latter are concrete. It is true the walls are thin, and on the score of economy the whole weight of the floors is carried on iron columns supporting cross girders, but the walls, fire-places, spiral staircases, &c., are all of monolithic concrete.

In Sialkot in the year 1886, I built a concrete bath 40 × 16 or 18 feet external dimensions with 8 feet of water; this exists in excellent preservation to-day.

On the Kangra Valley and Dalhousie cartroads there are several large span concrete bridges, on the latter road one of 60 feet. On the Amritsar Drainage Scheme, several bridges from 14 to 25 feet span both ordinary and skew have concrete arches, and on the B. D. Canal there is a bridge and fall entirely built of that material. In Peshawar the water pipes are of concrete; in fact, the application of concrete is so extensive that it is surprising indeed to see the closing sentence of "B's" article.

FITZHUGH COX,
Executive Engineer.

BANNU BRIDGES DIVISION; *May* 26.

MUNICIPAL APPOINTMENTS IN AUSTRALIA.

SIR,—In your reference to the Sydney Corporation it is rather hard lines to include all the Corporations in Australia under the ban they, the Sydneyites, so richly deserve. Melbourne, for instance, has a Council which well knows how to behave to good officers and they cannot for a moment be compared to Sydney, as they are greatly superior in every way.

I would point out that whereas the Melbourne Council took nearly 18 months to secure a really good Engineer in the person of Mr. Mountain, late City Surveyor here, the Sydney Council, on the other hand, are content that the position vacated by him should be filled, and very badly too, by a young man, who two years ago was in articles and has lately been plucked in his examination for Licensed Surveyor, and whose qualifications for the post may be judged from the fact that the other day when asked to sign a requisition for a piston ring, he stated he must first see

to what part of the engine it was to be fixed. Added to this he has been pushed over the heads of men senior to him in the office. The appointment is looked upon here as a job, as there are certain aldermen having large properties in different parts of the city who would be glad to get a tool in the Municipal service who would save them much expense at the ratepayers' cost. This is the common talk about such an absurd appointment. I send you a sample of this young man's compositions and ideas on ventilating sewers. There is a section of the Council who treat their Engineer like a dog and stop at nothing in their efforts to injure him, Trevor Jones, a well known man and a good C. E.

SYDNEY; *April* 26. L. S.

KARACHI DRAINAGE SCHEME.

SIR,—Referring to the report of Mr. J. Strachan on the sewage scheme of Karachi I beg to take the liberty of making a few remarks.

Paragraph 20 of the report says that the level of the starting points of the sewer at old town is 53·29 and that of the discharge at lower invert 64·79. This gives a rise of 11·50 feet which the report calls a fall, thereby causing an apparent confusion. But from this and other facts gleaned from the report and the attached map no reader of your Journal can miss the broad conclusion to be drawn that the Engineer contemplates (if he has not already committed the Karachi Municipality) an uphill work in which a sewer is to be commenced at the lowest point near the Custom House on the sea or the mouth of the river and carried upwards through cuttings varying in depth from 4 to 30 feet, and then the sewage is to be pumped up to manure an experimental garden. I am not aware whether this kind of Engineering ever pays its way; I cannot, however, believe that it does; besides I believe also that in a country where the ratepayers are properly represented (in England for instance) such a project would be severely criticised by the local public before it would see the light of publication, but in India a few *apka waste* Municipal Commisssoners and a few European admirers of the local Engineer (who perhaps never pay anything in the shape of taxes) are all the personages concerned in the expenditure of money squeezed from poor people. It is needless to say what such gentlemen cannot do, short of making the angels weep.

I believe Mr. Strachan's project could be carried out by starting the sewer at the highest point and making it follow the natural slope of the country which would save the necessity of pumping the sewage and at the same time feed a certain number of gardens.

As the report says nothing about the creek or the river or draws any comparison with the drainage of Calcutta it is difficult to say whether the river banks on the sides of the creek would be the best place for the sewer gardens, but in either or both cases there would be no difficulty in using the sewerage if the pipes carry only the fœcal matter and not the rain water, for which I presume a separate scheme is intended; but if drainage and sewerage be both combined as in Calcutta the scheme would be perhaps more perfect and there would I presume be no difficulty in contriving to retain at each garden the solid matter and passing off the water into the river and the creek in a comparatively innocuous condition.

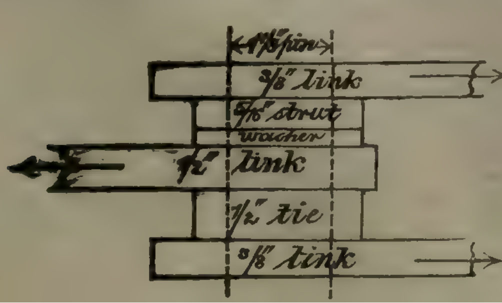
AN INDIAN OBSERVER.

GARSON'S PATENT SUSPENSION BRIDGE.

SIR,—With reference to your correspondent "F. E. R.'s" criticisms on Garson's Patent Suspension Bridge, we feel called upon in justification of this special type of bridge to further explain as follows:—

We have already replied to "F. E. R.'s" original remarks; which reply, coupled with the explicit references of your correspondent F (x) in your impression of 26th March as to bearing area on the pin, will reduce his objections to nothing.

In your impression of 2nd April, however, "F. E. R." ventures to criticize the method of packing the bars on to the pin without having seen any detail drawings, and shows a diagram which is absolutely misleading, assuming also in a free and easy sort of way, that such packing "would be probably as good as any other". Now to this question we beg to reply that the best packing to obtain the most equable transmission of strains would naturally appear to any practical engineer to be, by placing the single ½" link midway between the two ⅜" links, with 5/16" strut (+ 3/16" washer) and ½" tie on either side, thus:—



There will then be no disadvantageous bending stresses on the pin, which we repeat would efficiently answer its purpose.

As to wear in the pin joints it will be easily seen by reference to the original drawing that this type of suspension bridge, by reason of its being composed of two rigid systems of framework to each chain, allows no motion on any of the ordinary pin connections, so that these cannot possibly wear out.

The principal pins, however, which are situated at the central hinged joint and at the tops and bases of the supporting columns, are liable to a very slight wear (hardly appreciable) which has been amply provided for in their extra strength and bearing area.

We regret that the great distance intervening between us and your publishing office has prevented our replies appearing before you at an earlier date.

A. & J. MAIN & Co.

GLASGOW; *April* 28.

FROUDE'S METHOD OF SETTING OUT RAILWAY CURVES.

SIR,—Can any of your correspondents enlighten me upon the following points?

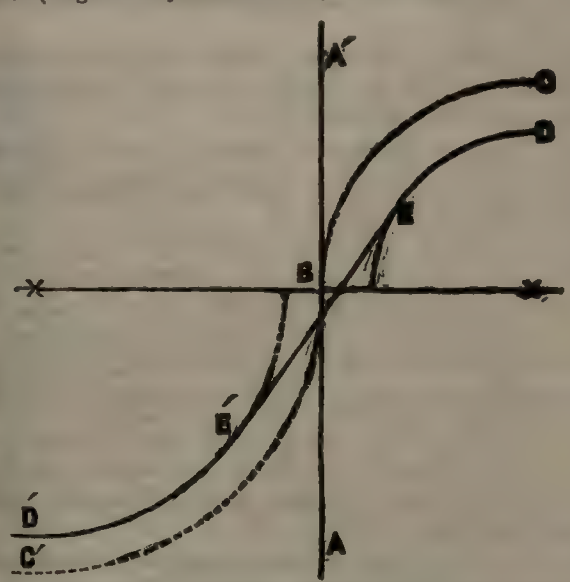
There appears to be something wrong with Froude's method of setting out railway curves with adjustment, given in Rankine's Manual of Civil Engineering, which method for the convenience of those who have not the book to refer to, is briefly this:—

Set out the usual circular arc.

Make the length of "adjustment curve", the length required to give the usual cant, on a grade of $\frac{1}{800}$ from zero.

Shift the pegs of curve inwards (towards centre) an amount calculated thus:—

Shift = (length of adjustment curve)^2 ÷ 24 radius.



Thus, in the figure the reverse curves BC, BC′ have been shifted inwards as at ED, E′D′, CD being the "shift."

The curves are then connected by a gradual curve, for the offsets of which from original curves, a formula is given, of which more anon.

So far, there is no difficulty, for the two curves can obviously be connected with advantage, by a straight EE′, within the length of which the cant can be eased down.

But when we come to the more frequent case of a curve leaving its tangent, supposing E to be the point whose adjustment should terminate, I cannot see how it is possible to get from B to E without having, for some part of the way, a curve of *less* than the original radius, whereas it is expressly stated that the rate of curvature increases gradually, from zero at B to radius at E.

Nor would matters be improved by shifting the curve outwards, for still there must be in this improved part, a length of sharper radius than the original.

As regards the formula for intermediate offsets, it is this:— Taking E, the end of "adjustment curve" as origin, and setting the ordinates normal to the original curve CB, $y = \frac{4bx^3}{a^3}$,

where y = ordinate,
a = length of adjustment curve,
b = amount of shift,
x = distance from E.

Now it is evident that at the limit, where $x = a$, y should simply $= b$, the amount of shift; but by this formula it is $4b$, without any specified limit to x or y. This is another difficulty.

A numerical example is given in Rankine, where with a curve of 1320′ radius, and cant for a 40 mile speed, the length of adjustment curve is given as 113′·6, and the shift CD as 0″·4. Now, as the offset from the tangent for these proportions is 4′·8, it does not appear that tempering the curve to the extent of 0′·4 in that length, would have much practical effect, even if geometrically correct.

F. E. R.

General Articles.

NIRA CANAL.

By J. E. Whiting, M.A., M. Inst. C.E.

I proceed to describe the means by which the storage of the Batghur reservoir for the supply of water to the Nira Canal during the dry weather is to be increased without raising the dam or the permanent crests of the waste weirs. These waste weirs have an aggregate length of 810 feet and consist of 81 spans of 10 feet each; over these a roadway is to run which will also traverse the entire length of the dam. The maximum floods during the monsoon are estimated to rise 8 feet over the crests of the weirs. The crests will be left perfectly free during the monsoon, but on 1st of October 37 of the spans will be closed with steel needles, each 9′ × 9,″ which will be described hereafter, and the remaining spans are to be closed by gates 10′ × 8,′ so contrived that if a flood should occur in the Yelwandi valley during the cold weather these gates will either entirely or partially fall so as to allow the flood water to pass and then they will be reclosed. They constitute, in fact, safety outlets, and would, if they all fell, allow a flood of over 35,000 cubic feet to pass over the waste weir. This is much more than any flood that has ever been observed in the valley after the end of the monsoon.

Now the area of the lake being very approximately seven square miles at level of crests of the weirs, it is manifest that these gates and steel needles will enable us to store at least seven square miles of water 8 feet deep,—or say 1,550,000,000 cubic feet, thus making the total storage up to 5,550,000,000 cubic feet, and this will be probably the largest amount of water available for irrigation in any tank in the world.

It may be asked how the canal will be served from the end of the monsoon and while the top depth of 8 feet is being stored by the gates and the needles? This brings out one of the features of the Nira project, namely, that the reservoir has been constructed in one tributary out of five that go to make up the Nira River floods at the canal head works, so that although the Yelwandi be held up there will still be four sources of supply to the canal and the water from these will be more than sufficient for it until the middle of November generally, and from that date only will the storage of the Batghur reservoir be drawn upon.

It now remains to describe briefly the falling gates. It is believed they are entirely new in design. As already stated they are each to be 8 feet high by 10 feet wide; they will consist of buckled steel plates ¼″ thick, 8′ × 10′, with suitable angle iron stiffening at sides and along the top, but to the lower edge of the plate a bulb iron will be rivetted in such a manner that the bulb will project and form a joint inside a suitable socket or casting that will extend from pier to pier of the opening. These piers, as already described, are to carry a roadway and they are to be so built that the buckled plate, as it turns about the socket joint, will close against bevelled surfaces at each side or rather canvass padding at the edge of the plate will be pressed against the bevelled surface of the masonry piers and so make a water-tight joint at each side. It should have been stated that the gates are to be shut towards the water and that they will be pulled upwards by strong chains, one on each side of the gate. These chains pass over pulleys and their lower ends are attached to large blocks of masonry which hang freely within cisterns built in the body of the wall. The blocks of masonry are of such size that when a gate is shut against a head of 8 feet of water there will be a tension on the ropes from the weights 500lbs. greater than the resultants of the pressure exerted by the water and acting at the attachments of the chains. That is to say, the gates in a normal state of affairs are held against the bevelled edges of the masonry piers by a pull of 500 lbs. This has been found on an experimental gate which has been several years in action to practically prevent leakage.

It now remains to describe how the gates will open when water rises more than 8 feet above the sills or crests of the openings.

In each pier and on the lake side of the gate a pipe is to be built leading down from an opening (8′ above sill) to the cisterns in which hang the masonry blocks described above. As soon, therefore, as the lake rises above the safe level, water will freely pass into these cisterns through the pipes, and as soon as the masonry blocks are submerged they will, of course, lose (apparently) weight equal to their volume in water. The stone at Batghur is very heavy (180lbs. per cubic foot), so that nearly one-third of the total tension will cease when the blocks are submerged by water entering the cisterns. In other words, nearly 1,500lbs. will be relaxed and there will be an excess pressure against each gate equal to nearly 1,000lbs., tending to open the gate. As a matter of fact the gates will open long before the cisterns are full; an excess of about 100lbs. causes motion and the gates begin to allow water to pass over their top edges. Of course if the flood begin to fall the cisterns would empty themselves, for small outlets have been left on the down stream face of the weir to allow escape of water from the cisterns, but if the water continues to rise and to flow into the cisterns the gates will infallibly open, for the pressure increases on the gate as it assumes a horizontal position and exerts also a greater moment to open the gate. In order then to prevent too rapid falling, side passages are to be cut in the piers so that water will pass under the buckled plates and so break the fall.

So long as two feet of water are passing over the fallen gate the pressure will not permit it to rise even when the cisterns have run dry, and arrangements have accordingly been made to let down auxiliary chains from the roadway above, and then by differential blocks the requisite assistance will be given to shut each gate.

It is not contended that the gates will shut themselves without help; this is the minor point:—all that has been aimed at and attained is perfect security that the gates will open if an unexpected flood comes down the valley. A little time will be expended and some storage lost before the gates can all be reclosed, but it is probable that with a flood of sufficient magnitude to completely open all the gates, there will remain sufficient run off from the Yelwandi hills to restore nearly, if not completely, the full 8 feet of surface storage. A few details will perhaps be desirable regarding the working parts of the gates:—

1st.—The attachments of the chains to the gates are placed so as to lie behind recesses in the piers so that these attachments and the chains will be out of the direct flow of water as the gates open. Experiment shewed this precaution to be very desirable so that trees and brushwood may not catch in the chains.

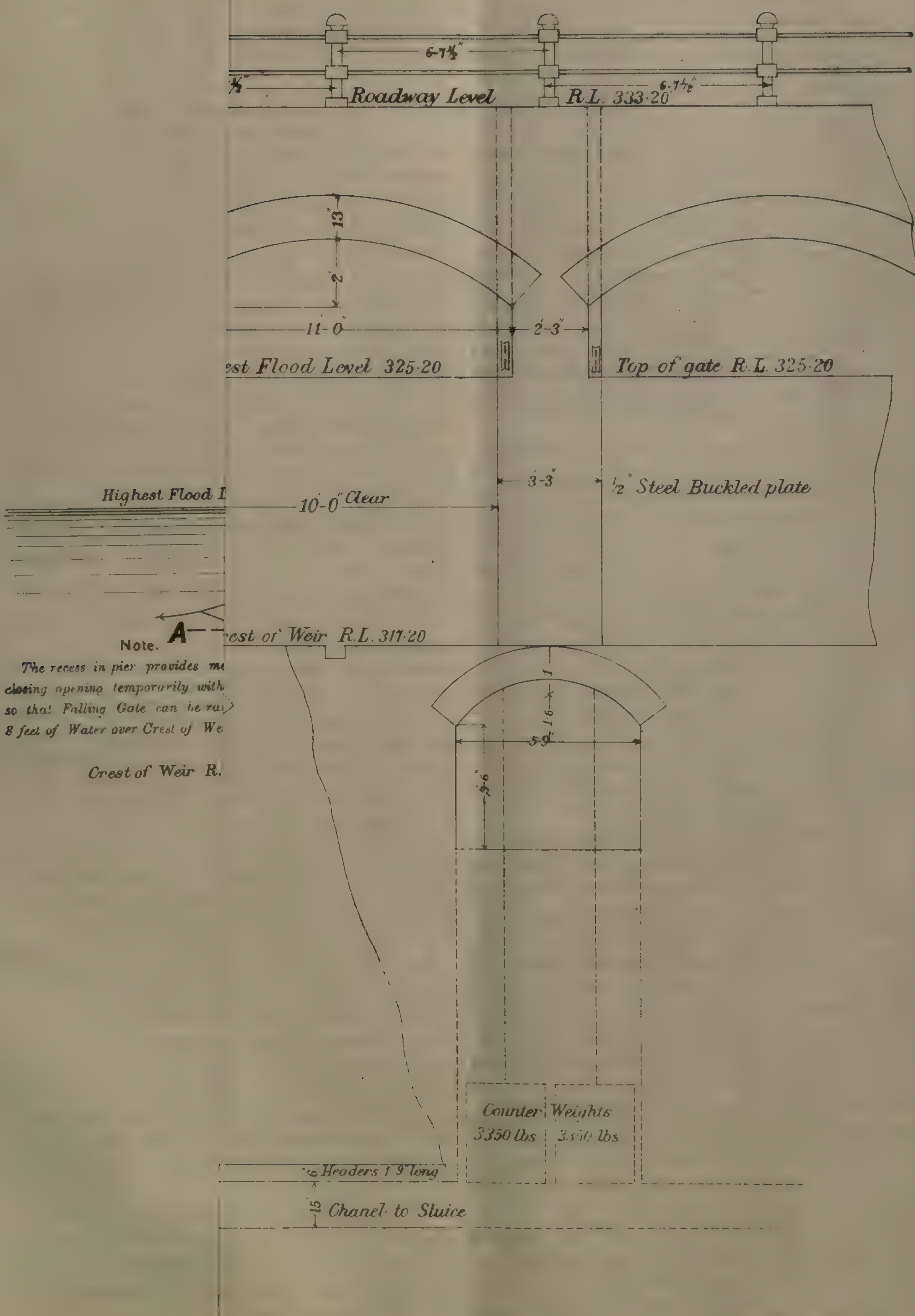
2nd.—The final position of the gate when pressed against the bevelled edges of the piers is sloped slightly to the vertical so that the pull of the chains may never tend to lift the gates out of their socket joints, but on the contrary always to pull the gate against its bearing and the bulb against the cast-iron or brass socket. The more the gate falls or opens the more will the chains pull it back against its joint. These devices make an open joint safe, and manifestly it is a great advantage to be able to put in or take out a gate any time if necessary.

3rd.—For each gate four pulleys are used, two on each side; but these are placed so that nothing can float into them and foul the chains.

4th.—The packing consists of cotton rope held in tarred dungree and canvass, the edges of which are held between the angle iron and the buckled plate, so that the covered rope projects sufficiently beyond the buckled plate to jam against the bevelled edge of the masonry pier.

The experimental gate is 8′ high by 4′ wide and has acted during three monsoons automatically and has given no difficulty whatever, excepting that brushwood occasionally catches on the chains *after* the gate is open and this has sometimes to be removed before the gate will shut. The self-opening action has never failed. Directly

Elevation.



J. E. WHITING.

water enters the cistern, and as stated above the arrangement for the chains is so far altered that they will be protected behind recesses and entirely out of the way of brushwood when the gates are open—the water flowing past the gates at Batghur.

It will be seen that all apparatus is of the simplest kind and very cheap, and easily put up and kept in order. With 8′ head the leakage is practically nothing.

J. W.

REPORT ON THE PREVENTION OF THE WASTE OF WATER.

By S. Tomlinson, Assoc. M. Inst. C.E., F. R. Met. Soc., Deputy Executive Engineer, Water Works, Bombay.

II.

(Conluded from page 323.)

With reference to the divisions (1) and (2), I do not think any change can at present be wisely made. The demand for domestic purposes—the great object of an urban water-supply—is not fully satisfied, and until it is, I think no revision, by way of reduction, can be made in the charges for meter supplies. As to No. 4, it is not probable that any great change would be accepted in the scale of charges to such institutions. It may, however, not be generally known what a large quantity of water is consumed in these institutions. The free supply to dipping wells and fountains must, I presume, be continued without change. These number at present about 160. From the ascertained draughts of several of these I believe the average supply may be taken at about one million of gallons per day for this number, or say about 6,000 gallons per day each. The leakage in two instances amounted to 40,000 gallons per day. For road watering probably during the dry season 300,000 gallons or 1,200 carts per day are used.

As to waste, the former report shewed at present, say, 60 per cent. In Liverpool the waste is now about 33 per cent. I do not anticipate it can ever be less than 25 per cent. to 30 per cent. of the total supply in Bombay and, when water-closets with cisterns and ball-cocks are introduced, will probably be more. The waste from these in Liverpool and Bradford is more than from all other causes put together.

In calculating therefore the cost of the water to be disposed of allowance must be made for the above. The total supply to Bombay is 14,750,000 gallons per day, as per previous report.

	Gallons.
Deducting $\frac{1}{3}$ for waste $= \frac{14,750,000}{3} =$ say	4,750,000
Dipping Wells and Free Supplies ...	1,000,000
Street watering, urinals, latrines, &c., average for 12 months	300,000
Charitable and religious institutions ...	200,000
Total Deduction ...	6,250,000

This leaves the quantity of revenue yielding water 8,500,000 per day.

The cost of maintenance and payment of interest, &c., was last year 1885–86 (*see* Administration Report, pages 130, 131), Rs. 6,71,190. For the present year, say, Rs. 7,00,000, or Rs. 1,918 per day.

This works out to 3·6 annas per 1,000 gallons. It seems, therefore, that 4 annas is the sum to be regarded as the cost-price of the water actually supplied to revenue-yielding-consumers.

It is this cost-price of water with reference to the payments made, where it is used for private gardens attached to bungalows paying water-rate on assessment at the same rate as where no garden exists, that I desire to draw your particular attention. It may be urged that the gardens give additional assessment to the bungalows. I hope the tables of meter-readings appended will show that any additional assessment they give bears no comparison to the aquivoracious character of the garden.

It will probably be agreed that, provided the supply can be afforded, it should be given, and the owners of the gardens complain bitterly when the water-supply is not sufficient. I do not think, therefore, that restriction, except when unavoidable, can be practised. But it seems only reasonable that, if a demand be made for water, it should be paid for at a reasonable rate. This seems to have been always the intention. There are instances of bungalows paying double assessment for the privilege of using water for the gardens; of additional payments to the ordinary assessments; of meters affixed to fountains, and the water consumed paid for at ordinary trade rates; and the present Bye-laws* provide against the use of water for ornamental or irrigational purposes, except when paid for by measurement through meter. At present a connection to a fountain is, by order of the Municipal Commissioner, not granted, except where the assessment amounts to Rs. 8 per mensem, or where the applicant agrees to pay that sum.

But the cases have not been regularly dealt with; the consumption for garden purposes is now, I find, so large, and the unpaid-for fountains and connections being almost general, I feel unable to deal with the question without further powers.

As soon as the monsoon passed away, complaints from Malabar and Khambala Hills began to come in. Nobody complained for himself or his servants, but everybody for the precious dying plants. In Gowalia Tank Meter District, we found the daily consumption increased in spite of the daily stoppage of leaks. I determined, therefore, to gather all the evidence I could on the question of garden consumptions. I affixed a meter to the main supplying the almost exclusively bungalow-with-garden district of Warden Road. The Assessor has provided me with the annual revenue derived from this district on assessment. Deducting that consumed through meter, and making on account of waste the allowance of one-third from the total consumption as was done in determining the cost-price of water (and I do not believe more can be recovered from this district), the Municipality is supplying water at a cost of 4 annas per 1,000 gallons and receiving in return 2·35 annas per 1,000 gallons. I have made a special inspection of a large number of bungalows on Malabar and Khambala Hills, Colaba, Byculla, and other places, and there can be no doubt that the consumption for gardens and fountains is not paid for at even nominal rates, in many cases, by the usual payment on assessment.

10. Nor does the question appear otherwise when viewed from the daily consumption per head of the population. This can only be done approximately, taking the census of 1881 as the basis. In the former report the figures for the three divisions were:—

	Gallons per day.	Population.	Gallons per head.
Vehar (Bhandarwada District, Native City)	$8\frac{1}{4}$ millions.	600,000	16
„ (24″) main, northern portion of Island	$1\frac{1}{2}$ „	80,000	19
Tulsi (Malabar Hill, Girgam, Fort & Colaba) ...	5 „	170,000	30

The summary of the supply in December to certain districts is as follows:—

		Gallons.
2nd Nagpada, per head per day		... 14·9
Kamathipura	„	... 15·0
Khetwadi	„	... 19·4
Gowalia Tank Road	„	... 42·7
Warden Road	„	... 106.8

Whether regarded in the three main divisions or by the closer tracing of districts, it is quite evident that the supplies to gardens consume far more than all other purposes put together, and that without payment because the usual assessment is not more than sufficient to

* Excerpt of Bye-law 10.
Private Water Service.—10. "Meters must be fixed wherever Municipal water is used for cattle, kept for purpose of profit, ornamental, irrigational or building purposes, or for purposes of manufacture or trade."

provide for the usual domestic requirements at fair rates. In one of the bungalows to which a meter is attached, and where the garden is very small, the consumption was 25,000 gallons, whilst the requirements for fifty persons and six horses were only 56,000 gallons, during the same period. In another case the garden consumption was 67,000 gallons against 22,000 gallons for domestic purposes, and here restrictions were introduced on the garden consumption when it was found a meter had been fixed. In the other cases it is not practicable to divide the consumptions.

As the number of gardens in Bombay is now very large and is continually increasing, I trust I have been able to shew that some change is required in the system of payment. There are two or three ways in which the change could be made :—

1. By fixing meters where water is used for gardens, either to the whole supply or to separate connections for the garden supplies.

2. By payment of some sum per square yard of garden area.

3. By special rates of Assessment where there are gardens.

4. By regarding fountains and taps in gardens as extras, as is done in many Home and American Companies and Municipalities.

I have visited a very large number of bungalows in order to be able to consider which of those methods would be the best suited for Bombay. I am strongly in favor of the last course. It does not introduce the principle of measurement for domestic purposes, which, I think, is strongly to be objected to, and yet preserves the owner or occupier from having the expense of laying down, at in some cases great expense, separate pipes, and it saves the disputes, trouble and expense consequent on the introduction and use of so many meters, and the tap being the outlet for the water we are directly assessing the drawing capacity of the occupier. The assessment per square yard would, I expect, be much and reasonably disputed. Some small gardens use much water and other large ones less, and we should then merely be thrown back upon a system of allowing so many taps per unit of area. There are many cases in which a supplementary supply is obtained from wells, and here a reduction could be reasonably claimed. Disturbing the ordinary assessment as in the third way, would lead to many alterations and re-alterations in the Assessment Books.

I therefore consider that a sum of, say, Rs. 4 per mensem for each tap and Rs. 8 for each fountain, with an allowance of 1,000 gallons total storage, would be the best method of recovering the extra charge if, as I trust it may be, it is decided to be done. This could be recovered by returns forwarded from this office to the Assessor and Collector in the same way that consumptions through meters are now presented. The work of determining what was a garden connection would, I presume, fall on this deprtment, and if so, I should be prepared to undertake the first general survey personally.

In conclusion, I would summarize the points which, I venture to submit, require attention.

1. An increase of the Waste Prevention Staff so as to be enabled to vigorously carry forward the work.

2. The adoption of some system for recovering revenue from gardens.

An affirmative determination on these two points would, I have no doubt whatever, lead to an increase of net revenue and a more regular and satisfactory supply of water to the city.

BOMBAY, *January* 26, 1887. S. T.

GENERAL R. STRACHEY, R.E., is to be the President of the Royal Geographical Society during the current year in succession to Lord Aberdare. The founder's medal of the Society has this year been awarded to Lieutenant-Colonel T. H. Holdich, R.E., Deputy Superintendent, Survey of India Department, for the eminent services he has rendered to geography in Afghanistan.

MEMORANDUM ON RE-BURNT PORTLAND CEMENT.

BY DR. EDWARD NICHOLSON, *Late* ARMY MEDICAL DEPARTMENT.

REBURNT cement may be used instead of ordinary cement; but its energy is so great that it must be diluted with the latter unless it can be used at once. The following is the rate of setting under water, and mixtures can be made according to the special purpose required :—

Reburnt cement neat ...	... 2 minutes.
Do. do. + 1 ordinary cement	... 5 minutes.
Do. do. + 2 do. do.	... ½ hour.
Do. do. + 3 do. do.	... 1 hour.
Do. do. + 5 do. do.	... 3 hours.
Ordinary cement	... 16 hours.

After 18 hours under water, when the slowest of the above compositions would be set hard, the adhesive strength was found to vary but little from 6·1 lbs. per square inch with reburnt cement neat, to 4·6 lbs. per square inch with ordinary cement.

Dilution with a moderate amount of sand (equal part) did not notably affect the setting or strength of the above compositions.

Portland cement damaged by being hardcaked did not give such good results when simply reburnt, as when previously mixed with water and made into brickets.

The damaged cement, ground if necessary under the wheel, should be made into paste and spread out in a layer about 2 inches thick on a stone floor. The mass should be divided into convenient sized bricks while still soft. After 24 hours the bricks may be stacked until required for burning; they may advantageously be watered for a few days after making. The bricks may be burnt at a temperature lower than is required for lime; and 6 or 8 hours burning is sufficient. When burnt they are quite friable and are ground as easily as common clay bricks; this may be done under the common stone-runner mill.* Before packing the cement should be aired in a thin layer for about 48 hours; a sample made into paste is packed into a small chatty of 2 or 3 inches diameter, which is at once immersed; the paste will set suddenly in about 2 minutes; but if the cement be not sufficiently aired, it will expand and crack the chatty after a time varying from 10 minutes to 2 hours. The aired cement should be packed in barrels until required; its energy will not diminish for a month or even much longer, but it is best to burn no more bricks than can be used within the next three months.

* The ground cement should be passed through a sieve of 36 meshes (or better 48 meshes) to the linear inch. Brass wire gauze of these numbers is made in England.

SEWERAGE SCHEME FOR KARACHI CITY AND ITS SUBURBS.

BY J. STRACHAN, M. INST. C. E., MUNICIPAL ENGINEER.

(Continued from page 269.)

IV.

21. THE land selected for the sewage farm is at its highest point 94·56 above datum, which is 50·00 above mean sea-level datum.

22. With respect to the Engines to be employed for the pumping work, I think it will be unnecessary to enter into details at this stage. Full enquiries should be made as to the latest improvements, with special reference to economy in the matter of fuel. Makers should be requested to submit, along with their tenders, drawings and specifications for examination.

The Engines at pumping station will have to be able to pump 2 million gallons of sewage in 10 hours a height of 16 feet and force the same quantity a distance of 7,800 feet with a rise of 39 feet. To do this an Engine of, say, 70 Horse-Power will be required, and to provide against accidents, it is usual to provide a duplicate Engine. These would cost, with Engine-house and pumps complete, about £7,000. The general practice is, as I have said, to have

Engines in duplicate, but for Karachi I would recommend that the Engines be of less power and in triplicate, for there are seasons when much less pumping will have to be done than at others and when it will be an economy to have a small Engine to do it. The first cost of Engines in triplicate will be much less than the first cost of the Engines of larger size in duplicate, and the cost of working will certainly be much less. Thus I would recommend to have instead of two 70 Horse-Power Engines three of 35 Horse-Power, which would cost, including pumps and the necessary buildings, about £5,600.

23. In carrying out a sewerage scheme the following are the general principles which have to be adhered to:—

a. That all storm water is to be excluded from the sewers as far as possible.

b. That storage capacity be provided for the night flow of the sewerage, as the pumps will only be worked during the day.

c. That the storage reservoir should be cut off from the outfall sewer by a flap valve, so that no sewer gas may rise by the drains towards the Town.

d. That all sewers be built perfectly water-tight, so as to exclude all subsoil water.

e. That all pipes sewers should be laid in straight lines and that air shafts should be provided at each change of direction or inclination of the sewers, so that provision may be made for the proper ventilation and inspection of the entire sewerage system.

f. That provision be made for flushing the sewers where necessary.

With regard to the subsoil water it has been found that at a certain part of Camp it stands at a level much too near the surface to be satisfactory for those living in the neighbourhood. This high level is confined to one small part only, where there has been an old *nullah* which formerly carried off the storm waters of this part to the sea. I am not inclined to think that any special arrangement will have to be made in connection with the general scheme of drainage to remedy this. A drain laid from Victoria Street, through the Superintending Engineer's compound and leading into the *nullah* at Kutcherry Road, would, in my opinion, be sufficient to remedy the evil and to reduce the level of the water to what it was before the Malir Water was introduced.

24. Provision will be made for private connections with the drains as the work proceeds, and the Corporation will have to decide on what terms, and by whom these shall be made. It should be part of the scheme that all the present cesspools shall be opened out and disinfected; filled in with sweet earth and closed finally on the works being sufficiently far advanced to receive the sewage on the land. This work will require most careful supervision and should be carried on with the utmost caution. Not too many pits should be opened at one time; their contents should be immediately carted away and the holes filled up with large quantities of fresh earth and quick lime. Deodorants and disinfectants should be freely used, of which sulphate of iron and carbolic acid are perhaps the most efficacious as well as cheapest. All private connections should be most carefully made and trapped, and in the narrow streets and lanes of the town, besides the ordinary man-hole ventilators, pipes should be connected with the house drain between the traps and the houses and carried up the fronts of the houses a few feet above the roof. Private water closets will also be connected with the sewers where desired, but the Corporation should register all such and cause them for some time at least to be periodically inspected. There is great danger that the inhabitants, ignorant of the mode of action of these closets, will endeavour to get rid of all sorts of rubbish through the opening and thereby derange their working. A little experience of their management will no doubt soon prevent this happening. It will be essential, however, that all closets be connected with a water cistern in the house, so that the house drains may be properly flushed. I would recommend that these closets be all of one description for the native community, one without a seat will be the best, with the top of the pan a few inches only above the level of the floor, and self-acting, so that the tumbler of the cistern discharges a certain quantity of water into the pan immediately after it has been used. The public latrines and urinals should all be constructed on the same principle.

In the rough estimate, which accompanies this report, provision will be made for a complete service of latrines and urinals, there being few of the former and none of the latter in the Town at present. The type of public latrine will also have to be carefully considered. It must be constructed of non-porous material and the pans should be without corners or angles. The floors must in all cases be of non-porous materials and, if possible, the walls also for a certain height.

25. Arrangements for flushing the sewers should be made by means of Field's annular syphon, or others of a like description, being fitted at each street Water service, at each dead end or where necessary. These syphons are very cheap and also very efficacious. They are automatic in their action, and are thus described by the Resident Engineer under Mr. T. Hawkesley, M.I.C.E., at the Aylesbury sewage works:—"The flushing tank answers the purpose for which it was designed most fully, as it not only keeps 75 yards of the new sewers clear of deposit, but extends its beneficial effects much further, though in a less degree. It is found that the condition of the sewers has been much improved since the flushing tanks have been in operation. The size of the sewer varies from 24, 30 to 39 inches and the inclination from 1 in 600 to 1 in 800."

26. Before closing this report I desire to embrace the present opportunity of urging on the members of the Corporation, in the strongest manner possible, the necessity of taking steps to admit a little more fresh air and sunshine into the recesses of the Native Town. This I would accomplish by running a broad wide street of the size of Napier Street through the centre of the Town from South-West to North-East. No time could be more opportune for doing this than when a large work, like the one now proposed, is being carried out. In taking up land for the new road sufficient should be taken for a road 90 or 100 feet wide and for plots averaging forty feet deep on each side, so as to enable the Municipality to sell plots for shops and houses along the frontages of the new street. If this were done I feel convinced that those sites would be so much in demand and would sell at such a high figure as would leave in the end a very considerable balance in favor of the Municipality. But this would not be all the good that the scheme would effect, for many houses of a most unhealthy description would be removed and others of a new and improved character would be built in their places.

That something in the nature of this proposal is now required will be readily seen from a report I submitted to the Municipality as far back as 1877. I then said a stranger on walking through the native Town of Karachi will at once be struck with the want of ventilation in the streets. It struck me forcibly the first time I visited the Town and I have ever since been strongly impressed with the necessity of supplying this want. Doctor Leith, Surgeon-General of Hospitals and President of a Sanitary Commission, in his report on the sanitary condition of Karachi in 1867, after having described the native Town as a collection of houses, built side by side, and back to back without any interval, traversed by small unpaved courts, mazy passages and blind alleys, with one side of the house only by which air and light can be admitted, goes on to say,—"were it not for the wind towers or badgeers, that are in universal use it seems impossible that human life could be maintained in such dwellings. Every house and hut has its wind tower rising above its flat roof and with its opening direct to the South-West." No amount of such openings could compensate for the want of free access of fresh air into the passages and courts and lower apartments of the

houses, and the Municipality should not delay to open straight and wide thoroughfares through the town. Very much has been done for the improvement of the Town generally, but with regard to the ventilation, nothing has been done, want of the necessary funds required to carry out such an extensive improvement has of course been the cause of delay, and may yet be a cause of still further delay where so much remains to be undertaken. The works could be commenced from the South-West end of the new street and proceeded with gradually, and though it took ten years and many thousands of rupees to complete the work, it would be worth all the time and all the money. I have shewn on the plan the land which would be required for the new street as 100 feet wide; this width of course does not include the plots of about 40 feet wide on each side which would be resold by the Municipality for the purpose of erecting shops and houses wherewith to face the street.

The need for ventilation is now far greater than before, for houses have been built, where small plots of vacant ground formerly existed, and where houses have been rebuilt they are of a better description certainly, but they tend to shut out the light and air more effectually than the old ones, inasmuch as they are generally much higher. I think the native members of the Corporation should take this matter up. It is one on which much of the comfort and happiness of their fellow townsmen depend.

27. Appended is a rough estimate of the works connected with the scheme of sewerage amounting in all to Rs. 7,77,416.

I have not attempted to estimate the cost and anticipated income from the formation of a new road, but will be most happy to give the Municipality the benefit of my views on the subject if there appears to be any desire to take up the question.

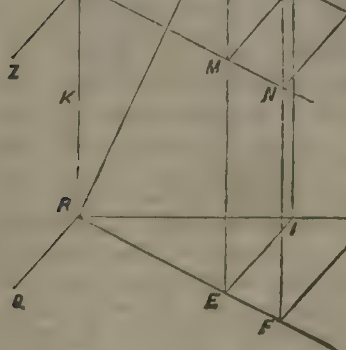
(To be continued.)

THE GEOMETRY OF THE OBLIQUE ARCH.

By A. Ewbank.

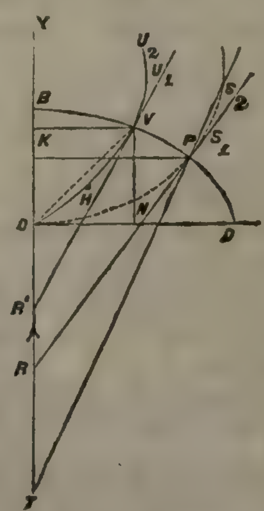
VI.

Fig. 10*a*.



We have now to inquire whether this point R is common to all other tangent lines drawn at points where the face coursing curves are cut by the ellipse in that face. In *fig.* 12 the curve S_2 S_1 meets the ellipse at P. Another *group* of spirals will have crossed the plane A Q B of *fig.* 11 at a line different from O x. Let the initial spiral of this new group cross at the front W.

Fig. 12.



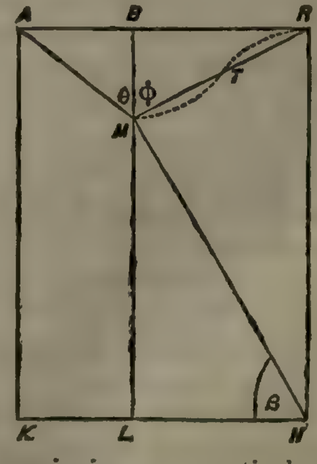
Let A O W$=\lambda$ in circular measure. This initial spiral may be denoted as regards any point V on it by the equations $x=r$ Cos a, $y=r$ Sin a, $z=mr\,a-m\,r\,\lambda$ where as before a is a variable angle. The second spiral of this new group may as regards any point U_1 on it be defined by the equations, $x_1 = r_1$ Cos a_1, $y_1=r_1$ Sin a_1, $z_1=m_1$ r_1 a_1-m_1 r_1 λ. For this second spiral crosses A Q B at a point W_1 on O W produced. We may now use the *fig.* 10 *a* for the chord U_1 V. For the point P we have to substitute V. For S_1 we have U_1 and the value of O R_1 which we shall obtain will give the point R_1, where U_1 V produced cuts O y. If we obtain the same value k_1 for O R^1 as before we obtained for O R then Buck's theorem, as here generalised, is established.

As before since U^1, V, and R^1 are three points on a straight line $\frac{\text{O H}}{\text{O L}-\text{O H}}=\frac{\text{O R}^1+\text{V M}}{\text{U}_1\text{ N}-\text{V M}}=\frac{\text{M H}}{\text{N L}-\text{M H}}$ where O $R^1=k^1$.

As before $k_1=\frac{r\,r_1\text{ Cot }\theta,\text{ Sin}\overline{a_1-a}.}{z_1-z}$ Now when we subtract z from z_1 the quantity $m\,r\,\lambda=m_1\,r_1\,\lambda$ disappears. Thus we get $k_1=\frac{r_1\text{ Cot }\theta}{m}\,\frac{\text{Sin }\overline{a_1-a}}{a_1-a}=\frac{r\text{ Cot}\theta}{m}$ when the point U_1 moves down to V. Thus $k_1=k$ or O R_1=O R. That is the tanget line at V passes through the same point in y O produced as did the tangent line at P. Thus all the face coursing curves when they meet the ellipse give tangent lines strictly converging to one point.

In our case $m=\tan\beta$ or $k=r$ Cot θ Cot β. In the common arch $\theta=90°$, $\beta=90°$ ∴ $k=o$ or R coincides with O as we should expect. For any value of θ less than 90° and any acute angle for β the point R is below the roadway—the arch being a semi-ellipse.

Fig. 3.

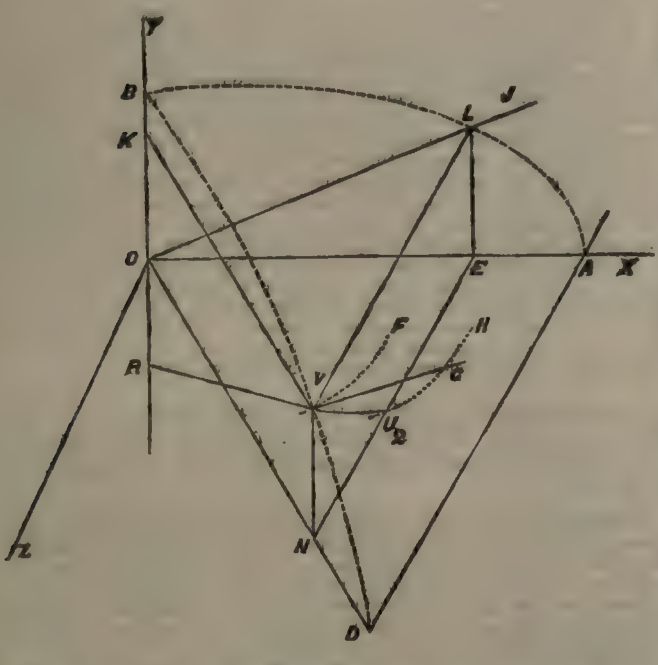


Thus without assigning any particular pitch to the intradosal spirals we still have the benefit of Buck's theorem in its now generalised form. We may, therefore,

in constructing an oblique arch, choose our pitch as seems desirable. In the case where we take the Buck pitch we see from *fig.* 3 that $\tan \beta = \tan \phi = \frac{\pi}{2} - \tan \theta$. In this case $k = \frac{2r \operatorname{Cot}^2 \theta}{\pi}$ which is the common expression for O R.

We may conclude this discussion by showing that such curves as P S_1 S_2 or V U_1 U_2 of *fig.* 12 are really, as has been stated, curved lines and are, moreover, concave towards Oy. In *fig.* 13 the curve B V D is half of the elliptic arch line. V F is the spiral line on the axis cylinder radius r meeting the ellipse in V. If V L be drawn parallel to the axis O z of the cylinder to meet the plane x O y in L, and a line V G be drawn parallel to O L, then any other spiral of the same *group* as V F passes through the straight line V G. As L O cuts the plane B O D of the arch at O, it follows that G V cuts the same arch face at V. The point G in the figure is out of this arch face and on the east side of it. The spiral H G of the same group must thus be produced to some point U_2 before it meets the arch face.

Fig. 13.



The point V is defined by $x = r \operatorname{Cos} a$, $y = r \operatorname{Sin} a$, $z = m\, r\, a - C$. The point G will have the same a as V has. Therefore if a_2 be the angle for the point U_2, $a_2 > a$. This was noticed before with respect to the curve P S_1 S_2. In *fig.* 13 V K R is a right angle and V R K is acute—as appears more naturally in *fig.* 12. In either figure V $K^2 = z^2 + x^2$. For in *fig.* 13 O E $= x$, E N $= z$ and V K^2 = O N^2 = O E^2 + E N^2. But $z = x \operatorname{Cot} \theta$ $\therefore$ V $K^2 = x^2 (1 + \operatorname{Cot}^2 \theta) = x^2 \operatorname{Cosec}^2 \theta$ $\therefore$ tan

$$\text{V R K} = \frac{\text{V K}}{\text{K R}} = \frac{x \operatorname{Cosec} \theta}{y + \text{O R}} = \frac{r \operatorname{Cos} a \operatorname{Cosec} \theta}{r \operatorname{Sin} a + \frac{r \operatorname{Cot} \theta}{m}} = \frac{\operatorname{Cos} a \operatorname{Cosec} \theta}{\frac{\operatorname{Cot} \theta}{m} + \operatorname{Sin} a}.$$

If now we suppose the tangent to the same curve V U_2 to be drawn at the point U_2 and to make an angle δ with O y we shall have in the same way

$$\tan \delta = \frac{\operatorname{Cos} a_2 \operatorname{Cosec} \theta}{\frac{\operatorname{Cot} \theta}{m_2} + \operatorname{Sin} a_2}.$$

Now $m_2 r_2 = m r$, where $r_2 = r +$ V G (see *fig.* 13) Therefore $m_2 < m$ and as $a_2 > a$ we have $\frac{\operatorname{Cot} \theta}{m_2} + \operatorname{Sin} a_2$ greater than $\frac{\operatorname{Cot} \theta}{m} + \operatorname{Sin} a$. Also $\operatorname{Cos} a_2$ is less than $\operatorname{Cos} a$. Thus $\tan \delta$ is less than tan V R K or δ is less than V R K.

This shows that the direction of the tangent at U_2 is different from that of the tangent at V, or that the line V U_1 U_2 is really curved. If the angle δ had been greater than V R K the curve V V_2 would have been convex towards O y. As δ is less than V R K the curve is concave.

By taking cylinders of radii smaller than O A of *fig.* 11 and considering the corresponding special lines of the same *group* as give the curve V U_1 U_2 we should by the intersection of these spiral lines with the same plane B O M obtain other points on the curve U_2 V prolonged through V. One such point is H in *fig.* 12.

These inner spiral lines pass through the line O W of *fig.* 11. The last of them is a spiral line drawn on a cylinder of radius *zero*. Therefore this last spiral line is *the axis* O z. In fact, because the product $m\,r$ is constant we see that when r is extremely small m must be extremely large. Now m = tangent of the pitch. Therefore the pitch must be nearly 90° and this makes the spiral line nearly parallel at all points of its course to the axis. This reasoning may be compared with that in our earlier part of this discussion, where we saw that the intradosal coursing lines in the common arch were really particular cases of spirals.

Thus the curve U_2 V being continued through V ultimately reaches the point O. In fact more naturally it starts from O and the portion V U_2, which we originally obtained, is a part arbitrarily selected—so to say—by the arbitrary value given to O A of *fig.* 11. Or we may say it is determined by the accidental width of the roadway.

Of these curves which cut the ellipse B V D, one only, *viz.*, S_2 P, will, when produced to O, have its tangent at the point O coincident with the line O D of *fig.* 12 or *fig.* 11. If between the points P and B of *fig.* 12 we suppose that at every point of the elliptic arc is drawn such a curve as U_2 V and the curve be continued down to the point O and the inclination at O of its tangent line to the line O D be called γ, then the angle γ takes all values successively between zero for the curve S_2 P O and 90° for the curve through B, which latter has really lost its curvature and become the straight line B O.

In the foregoing demonstrations only ordinary Geometry and Trigonometry—as dealing with lines and planes—have been employed. It is hoped that the reasoning has been made clear, and thus that a question interesting both in Geometry and Engineering has been made accessible to those whose ordinary avocations have left them little opportunity for pursuing and extending their early mathematical studies.

A. E.

THE MADRAS HARBOUR.

Its Construction, Destruction, and Reconstruction.

XII.

In sending out the report of Sir John Hawkshaw and his colleagues to the Governments of India and Madras, the Secretary of State said that, so far as the engineering questions involved were concerned, their views should be accepted as closing the discussion on the principle of restoration to be followed, if the decision should be come to that the additional outlay which was requisite should be incurred. As Mr. Parkes generally concurred with the Committee, there was nothing to lead to hesitation in that respect. But before coming to a final decision to sanction so large an outlay, the Secretary of State desiderated a report on the financial aspect of the question.

In a letter forwarded with the Secretary of State's despatch, Mr. Parkes, in reply to a request from him, made his remarks on the Home Committee's report. He explained that though he had been in frequent communication with the Committee, and given them all the information and opinions he could, both orally and in writing, yet the conclusions given in their Report were arrived at quite independently of him. And he submitted that, in considering these conclusions, and taking action upon them, a large allowance must be made for the fact

that the gentlemen composing the Committee were not personally acquainted with the locality, and that their local information was obtained at second-hand,—from himself, Mr. Thorowgood and Mr. Molesworth he must have meant. And then, in pure Gladstonese, Mr. Parkes went on to apologise for the Committee, and to endeavour to make out that the details of their plan must not be adhered to. He then said :—

Subject, then, to the limitations implied in the above remarks, I may state that I have, after full consideration, come to the conclusion to acquiesce in the general recommendation of the Committee that the additional strength required should be given by a large wave-breaker, consisting of concrete blocks laid at random on the sea-face. I need not say that I have come to this conclusion with great reluctance, because it involves a very large additional outlay, which would have been saved if the more inexpensive plan which I proposed in March last had met with independent professional support. I do not think, however, that I should be justified in urging the latter further, even if my present opinion, that it would have possessed the necessary elements of stability, should remain unchanged, for I think this to be essentially one of those cases in which action should be taken only with a strong concurrence of professional opinion.

Nothing is here said about the Committee's insistance on the adoption of bond, or about the concrete cap, without which they did not consider the wave-breaker would be sufficient. Mr. Parkes thought that there might be a saving of seven or eight lakhs of rupees owing to more blocks of the old work being found available than the Committee assumed. And he said that at least four years would be required for the restoration, reckoned from the time of commencing block-setting which could not be started until the Titan Cranes had been replaced.

The action the Madras Government took on receiving the instructions of the Secretary of State upon the Home Committee's report, which were issued "in view to assisting the Government of India to arrive at a decision upon the course which it will be most desirable to follow in reference to the work of restoration," was to appoint a Committee to frame the needful estimates, and to consider the question of restoration in all its bearings. The Committee consisted of—

Colonel R. H. Sankey, C.B., R.E.	... *President.*
Colonel J. O. Hasted, R.E. ...	*Members.*
Lieutenant J. H. Taylor, R.N.R.	*Members.*
T. E. Marshall, Esq. ...	*Members.*
F. N. Thorowgood, Esq., M. INST. C.E.	*Members.*
N. St. B. Beardmore, Esq. ...	*Members.*
Major C. Bowen, R.E. ...	... *Secretary.*

The Committee were instructed that the views of the Home Committee were to be accepted as closing the discussion in principles; but as there were two distinct methods of applying the general principle to the seaward arms of the wall—(1) as per Section No. 3 of the Home Committee's Report, and (2) as per Section No. 4, and further as the Home Estimates were professedly only approximate, the Madras Committee were called upon to submit distinct recommendations, and as far as possible a detailed estimate, for the consideration of the Government of India. But they were also directed to consider the propriety of reducing the width of entrance as recommended by the Home Committee, and to submit such alternative scheme as might appear to them feasible, within the prescribed cost.

The Madras Committee submitted their Report on the 20th June 1883, or in less than two months after receipt of the orders of Government, and they appear to have worked well; but their interpretation of the orders of the Secretary of State, to consider the discussion on principles of restoration as closed, was different from that of the Madras Government, for they went into the question of reconstructing the elbows and seafaces on the random block system, and came to be of opinion that it was the proper one to adopt. They estimated in detail the cost of restoration on all the three systems considered by the Home Committee, and also the cost of closing the eastern entrance by each of them, and of opening out an entrance 500 feet in width through the north-eastern elbow, which alteration in the plan of the Harbour they strongly recommended for adoption, and they submitted a plan and cross-sections embodying their proposals, which, however, we cannot reproduce. The estimates were prepared by Mr. Thorowgood. Nor can we give as much space to the notice of their Report as we could wish. In submitting this Report to the Government of India, the Government of Madras thus summarised and backed it up :—

In the first place, as regards the estimated cost of the works, this Committee, on a close review of the rates of work, time required for execution, &c., find that to restore the break-waters on the plan most favoured by Sir John Hawkshaw's Committee (*i.e.*, as per Sections Nos. 1, 2, and 3 of their report) would be as follows, *viz.* :—

	Rs.
(1) While retaining the present Harbour entrance	... 50,93,980
(2) While reducing the entrance to 450 feet ...	... 51,85,580

The latter sum compares directly with the Home Committee's Estimate No. 1, amounting to £479,219-15-2.

As will be observed, the Madras Committee have shown by the highest nautical opinion that it would be dangerous to decrease in any way the width of the present eastern entrance, and that so long as this latter is left open, the Harbour must remain exposed, as at present, to continued disturbance, as well as being a perpetual source of the gravest anxiety to all concerned during cyclone periods. They further show that, while carrying out for the seaward arms the random block method of reconstruction, which is stated to be "a safe system to follow" by Sir John Hawkshaw's Committee, the objectionable eastern entrance may be closed, and a perfectly still-water harbour created, at a total outlay of Rs. 51,42,626, or for Rs. 42,954 less than that needed for reconstructing the works in the manner most approved by the Home Committee.

The incidental advantages of the plan suggested (see paragraphs 46 to 54 of the present Committee's Report) are so marked that His Excellency in Council trusts that they may be fully weighed in arriving at a conclusion in regard to the completion of this great work. Not only would the Harbour enjoy complete immunity from disturbance during ordinary weather, thus facilitating in every way all the trade operations of the port, but, what is of the highest moment, no ships need be sent to sea on the commencement of a storm. It is impossible, in the opinion of this Government, to lay too great a stress on this single fact, or to doubt the soundness of the reasoning on which it has been established. Not only, moreover, could the Harbour, under the altered conditions, be dredged out and its area increased to any required extent, but, as observed by the Committee, it might, by a suitable system of defences, form a complete harbour of refuge in times of war. As regards the resumption of the works, I am now to submit that every day's delay is adding to the cost of establishment, and continues the disadvantages under which the trade of the port has been suffering since the cyclone of the 12th November 1881.

Regarding the question of altering the position of the entrance to the Harbour, the Committee, after quoting the solemnly recorded opinion of their two nautical members, said :—

With this very distinct opinion of the professional officers before them, an opinion the validity of which, it may be observed, has long impressed itself on all who have had an opportunity of witnessing the effect of the waves which come in by the present entrance, the committee have felt that their duty would be very inadequately performed if they left unnoticed this blot on the present scheme, or if they disguised from the Government their clear opinion, not only as to the infeasibility of narrowing the present entrance, but as to the vital necessity for closing the latter completely if a quiet harbour is to be secured. No matter what the direction of the wind, the unceasing swell on this portion of the coast rolls in with the crests of the waves parallel, or very nearly so, to the coast line. In no case is it believed that the angle exceeds 30° to the general line of the coast. The result is that seas enter the present mouth freely, and owing to the small length of the Harbour, are not dispersed before reaching the shore at its base. The action is, of course, greatly intensified during storms, and particularly with the wind from the east. At such times the sea inside the Harbour, though not so high as outside, is certainly of a dangerous character, being exceedingly broken. Taking these and other facts into consideration, the Committee have to record their opinion that unless means be found for closing entirely the present entrance, no radical cure will have been applied to the chief defect of the work as at present designed.

The Home Committee, in many parts of their report, correctly draw attention to the unduly small area of the present Harbour, not much more than the outward half of which is suited for mooring vessels of any draft; but, as will, no doubt, at once be recognized, the proposals above made must, by affording the means whenever desired, of dredging out the shallow portions to any required depth, admit of doubling the useful area. An operation of this character, it is almost needless to say, could never be carried out so long as the present entrance remains open, the disturbance inside the Harbour being such that, with the exception of a very few days each year, would render dredging operations impossible, excepting at an altogether prohibitive outlay. Not only would the advantages here enumerated be secured, but in many other respects, such as the possibility of mooring ships much closer together than is at present feasible, bringing ships much closer to the shore, establishing wharves, jetties, &c., facilities to the trade of the port may be increased indefinitely.

We should have mentioned before that the Committee thought it most undesirable to attempt to erect the new superstructure on the ruins of the old work, and therefore of the two methods recommended to be tried

by the Home Committee they had no hesitation in recommending that of retiring the alignment behind the ruins of Mr. Parkes' work.

On receipt of the Madras Committee's Report, the Government of India lost no time in taking the opinion of Mr. Molesworth on it, in connection with the Report of the Home Committee. For the reconstruction of the ruined elbows and sea-faces, Mr. Molesworth adhered to his former proposal of random work, but admitted that it was desirable to increase the height of the breakwater above water-level, and he submitted revised cross-sections giving effect to this. He also recommended that no addition should be made to the rubble foundation on the sea side, but that the blocks should be deposited on it to a slope of 1 to 1, the French system, with a view to deflect the waves instead of allowing them to break; and he recommended that the rubble foundation should be added to on the Harbour side on the same slope of 1 to 1, to carry additional blocks on the same slope.

Mr. Molesworth also adopted the Home Committee's width of crest, 30 feet, with the top course made up level on bags of concrete; and the result of all this was an enormous addition to the number of blocks, per foot run, as compared with those shown in his first-proposed section. Mr. Molesworth also went at some length into the question of reducing the width of entrance, and calculated that even were it reduced to 450 feet as proposed by the Home Committee, a wave 30 feet high outside the Harbour would still cause a swell inside only 1 foot less in height than were the entrance left at 550 feet. At the head of the jetty, 2,500 feet from the entrance the swell would still be 5·74 feet instead of 6·78. He seemed inclined to favor the plan of closing the present entrance and opening one elsewhere, but did not approve of that proposed by the Madras Committee, and suggested alternatives,—for which we must refer our readers to his note, at page 171 of the Government publication, which is illustrated by several diagrams. Mr. Molesworth's opinions are thus summed up by himself:—

1*st.*—I recommend that the raising of the faces and elbows of the Harbour be accepted, but that the raising of the sides be postponed pending further experience.

2*nd.*—I recommend that the wave-breaker for the sides be only carried out at first for two or three hundred feet from the elbows, and that its completion be also postponed until the necessity for it can be determined.

3*rd.*—I recommend the adoption of the random block system on the *débris* of the original wall, but I advise that the sections be modified in accordance with the typical sections given in diagrams 1 and 2 appended to this note.

4*th.*—I recommend a postponement of the reduction of the width of entrance until it can be ascertained by practical experiment with fixed beacons that such a reduction can be allowed with safety to the shipping; and with regard to the alternative entrance from one side, I advise that the question be referred to some eminent nautical authority in India, bearing in mind that a concave face to the breakwater is quite inadmissible.

The settlement of the third point, namely, the method of reconstructing the face and elbows, is the only one that presses for an immediate decision, and it is very desirable to arrive at a decision on this point with the least possible delay, not only to enable the manufacture of blocks to be recommenced, but also to prevent further disaster to the existing works from future cyclones by protecting them with random blocks.

The case again went to Colonel Brownlow, and after having obtained information as to the strength, duration, and effect of the littoral currents at Madras, he convinced Mr. Molesworth that one of his suggestions would not do, namely, that the entrance should be to the south-eastward.

(*To be continued.*)

AERIAL NAVIGATION.

(Translated from *Annales Industrielles* for INDIAN ENGINEERING)

THE AERIAL BUOY: ITS INSTABILITY.

THE ordinary balloon, such as it has left the hands of the Montgolfiers and Charleses, has often been compared to a buoy. The comparison is correct up to a certain point, but is more to the disadvantage of the buoy than to that of the balloon, as we shall attempt to show.

A buoy is a floating body, but a body without a soul, blindly obeying the whims of the slightest passing current; the same may be said of the balloon, but there the analogy ceases.

While, on the other hand, the buoy, if carefully constructed, can float on the water for an almost indefinite length of time, the air balloon cannot balance itself and float in the air without the unceasing attention of the aëronaut.

Therefore, if the aërostat can be compared to a buoy, it must be to an instable buoy under water, and one that the slightest accident will cause to rise or sink. To transform the aërial buoy into an aërial boat, is it not necessary, above to first give it the stability it stands so greatly in need of?

But at the time balloons were invented, this problem was practically unsolvable, as will be seen when we have explained the causes of their instability.

To do this, we must imagine we are considering a buoy, but we will suppose that, instead of being light enough to float on the surface of the water, the buoy carries ballast enough to exactly equal in weight the density of that fluid.

Under these conditions, we will place it in mid ocean, under water, at a certain distance from the surface of the liquid; if everything continues exactly as in its initial state, our buoy will remain immoveable in the midst of the water, without either rising or sinking. But should its weight be accidentally added to, by shells for instance attaching themselves to it, and causing the apparatus to exceed in weight the fluid it displaces, it will descend by degrees into the depths of the ocean and will not stop till it reaches the bottom of the sea; for water being almost incompressible, is of a density perceptibly the same at all depths, and the weight of the displaced liquid will hardly increase at all during the descent of the apparatus.

Should, however, an accidental cause have lightened the buoy, it would have risen to the surface for the same reasons, having lost its equilibrium in the midst of the water. It is this instability of bodies entirely immersed which has hitherto hindered the practical realisation of submarine vessels.

These vessels are, in fact, liable to sink into the depths of the ocean should a current of water, however slight, cause their weight to increase. The fishes, however, are formed so as to effectually combat this instability and they do it unconsciously by using the powerful mechanical means with which they have been provided by nature.

Of late, similar means have been employed in the construction of submarine vessels of comparative steadiness, but their apparatus is still very imperfect in comparison to the magnificent floating vessels furrowing all the seas. It is evident, therefore, that if mankind had been condemned to navigate by means of submarine vessels only, maritime navigation would still be in its infancy and exist only in embryo.

Man is condemned to navigate the aërial ocean by means of an apparatus completely immerged; the sub-marine boat navigates *under water*, the aërial boat navigates *under air*, and the instability of the balloon is analogous to that of diving boats.

But, it will be said, air is not an incompressible fluid like water, and its density diminishing in proportion as we rise, an aërial buoy will therefore displace a volume of air of so much the less the higher it rises. And whatever may be its ascending force, this force will diminish to nothing at a certain height, at which height our buoy will stop. The same thing will occur, should an accidental heaviness be produced, the aërial buoy would at first descend, and then meeting with strata of air of increasing density, would lighten itself gradually until it is again in equilibrium.

This argument seems unanswerable; and, in fact, would be so, were it possible to construct balloons of steel, and close them hermetically in such a way as to render their volume unvarying at all heights. Unfortunately this cannot be done, the envelope of the balloon must be freely open in the lower portion. If this precaution were not observed, the aërostat on rising into the air and penetrating into regions of extreme rarification, would very soon burst on account of the interior pressure of the gas enclosed.*

A balloon, therefore, of unvarying weight and volume, is impossible. We must look upon the aërostat as a bag *partially* or *entirely* filled with gas, freely obeying the variations in weight of this volume of gas that shrinks on descending, expands on rising and freely escapes by a safety valve of extremely delicate construction, as soon as further expansion is

* A Balloon of Pongee silk, 10 metres in diameter, completely filled and closed at sea-level, would burst at a height of 400 or 500 metres, and a lightentng of 30 kilogrammes would suffice to carry it to that height.

rendered impossible—that is, as soon as the balloon is completely filled.

A.

(To be continued.)

ENGINEERING EDUCATION AND PRACTICE IN NEW SOUTH WALES.

(From an occasional Correspondent.)

The facilities for instruction in the various branches of the engineering profession that are now provided for the youth of New South Wales are equal in completeness of detail and extent of range to any that may exist in other countries. First and foremost stands the Engineering School of the University of Sydney, where graduates are required to pass through a complete theoretical training in a course which has been specially arranged to qualify them for all the duties of a Civil Engineer. The course extends over three years (including one year in arts), and consists of lectures and practical work in such subjects as physics, chemistry and in the sciences which bear more or less upon engineering. The students are also taught the use of the various instruments used in surveying and setting out engineering work and have to spend a good part of their time in the field. Instruction is given in designing, and preparing working drawings and specifications of structures and machinery. A laboratory is attached to the school which is fitted complete. The engineering lecture rooms are provided with a large and complete collection of models and parts of machines and structures, diagrams, drawings and a good technical library. In the laboratory the student receives practical instruction in the various processes involved in the preparation of materials used in construction, the quantitative determination of the efficiencies of prime movers and machines, and the testing of the strength of materials.

The Sydney Technical College ranks next in importance and is an admirable Institution supported by the State, which is doing valuable work in educating at evening classes a large number of young men who are otherwise engaged during the day. The College provides instruction, by means of lectures and laboratory work, in the various sciences, as well as practical instruction in a variety of important trades, such as boiler making, pattern making, smiths', fitters', turners', and plumbers' work, bricklaying, masonry, carpentry, and joinery. Instruction in mechanical drawing is also given, and a most complete set of models, diagrams, and drawings are at the service of the different lecturers.

It will thus be seen that the machinery of instruction provided for men who desire to become good engineers is ample and thorough, and it is a matter for surprise that the opportunities offered are not more largely availed of, especially in connection with the more strictly scientific course at the University. It would almost appear from this that the prospects of future employment are not sufficiently good to induce young men to sacrifice the time, money, and prolonged mental effort which are involved in obtaining a degree. The State has acted liberally in providing means of instruction for aspirants to the various branches of engineering, but it has stopped at that point, inasmuch as no provision has been made for drafting off any of the successful students into Government employment, although all the most important engineering works in the country are in the hands of the State. The scope for private engineering practice is very limited and there can be no doubt that the position of all engineers, outside those holding official positions, has lately been very distressing, and at no period in the history of this country has there been a larger number of men connected with engineering work unable to obtain employment. Private engineering firms have been obliged to reduce the number of their hands to a minimum and are doing very little business, whilst in the case of those professional men who have secured engagements, many have been forced to accept a rate of remuneration that would be refused by a labourer. It is to be hoped that under more favourable auspices, better seasons and general improvement in commerce and manufactures prosperity may soon replace the present period of depression. There can be no doubt of the superiority of a regular course of study qualifying young men to enter practically on the work of the engineering profession as compared with a system of pupilage, and all that is needed to increase the attendance of students at the University is the existence of some prospect that after working through the course there they will be able to attain a respectable and comfortable position in life.

NOTES FROM HOME.

(From our own Correspondent.)

Two gas buoys, on the principle patented by Messrs. Pintsch and Co., will be placed in the Crosby channel of the River Mersey. This important departure being the result of exhaustive, and most satisfactory experiments made by the Dock Board. The buoy on the west side will show a flash light, and that on the east side a fixed light, and they will be of great assistance to mariners when passing this dangerous channel at night. The buoys are charged with oil gas at a high pressure, each charge lasting fifteen days when burning continuously. The system has received the full approval of the Trinity House Committee.

A clergyman in Yorkshire has obtained a patent for a "safety electric lamp for mines." The chief feature in the device is the interposition of wire gauze between the carbon of an incandescent lamp and the exhausted envelope of glass in which the carbon is contained, so that in case of fracture of the glass the carbon is prevented from igniting any combustible mixture of gases or coal dust surrounding it.

The Hotel de Ville, Paris, possesses the largest electrical accumulator plant on the Continent; it has been laid down by M. Regnier with the advice of M. Planté. It comprises 165 giant couples of 26 centimetres diameter and 80 centimetres high. The total power of the battery is 80,000 Watts or 100 horse-power and it is used to regulate the lighting of 2,200 Edison lamps in the grand salon and the adjoining rooms which can accommodate 10,000 guests at a time. The battery is supplied from dynamos driven by engines of 130 horse-power. It weighs 11 tons and contains 4,500 litres of fluid. The cells are of Planté type of the original spiral model. They are more properly voltameters than accumulators. The scheme for this installation at first contemplated a plant capable of sustaining the lighting of the saloons for a whole night, but this was modified for what was called "budget reasons." As it is, no other Municipality has ventured upon so costly an experiment.

Interesting information has recently been published, shewing the growth of passenger traffic on the underground Railways, the leading omnibus, and the tramway routes of London, during the 20 years ending with 1884. From this it appears that the London General Omnibus Company previous to the opening of the Metropolitan Railway carried about 40 millions of passengers annually. The average fare was $3\frac{1}{2}d.$ and the cost to the Company $3\frac{1}{4}d.$ per passenger. The average fares by omnibus now are practically the same as the Metropolitan Railway, about twopence. The Omnibus Company now carries about as many as the Railway; about seventy-five millions each. In regard to cost, however, there is a great difference, the expense per passenger by omnibus being $1\frac{3}{4}d.$, whilst by Railway it is only $\frac{3}{4}d.$ On the Tramways about 119 millions are now carried; the average fare is about $1\frac{1}{2}d$ and the cost about $1\frac{1}{4}d$ per passenger. In the twenty years under consideration the traffic of the metropolis has increased 470 per cent.

The Association of Municipal Engineers held its third examination of candidates for the Association's certificate of competency on the 22nd and 23rd instant. Over 20 candidates were entered for the examination, which was held at the Institution of Civil Engineers by kind permission of the Council of that Body. The examiners were Mr. J. Lobley, President of the Association, Borough Engineer, Hanley; W. G. Laws, City Engineer, Newcastle-on-Tyne; E. B. Ellicelark, County Surveyor, Sussex; H. P. Boulnois, Borough Engineer, Portsmouth. It is announced that the next examination will be held in Manchester in October next.

It is announced that this Association has its annual Conference in July in Leicester, and that a visit is projected to Paris during the coming summer—where in the matter of drainage and sanitary works the members will no doubt have plenty of interesting material to visit and study.

A twenty-ton floating crane is illustrated and described in *Engineer*. It is here pointed out that with ever-increasing dimensions of our ships, the floating crane is found to be the most convenient form, offering greater facilities than any other system of lifting machinery. In this case the crane revolves entirely round; the point of the jib describing a circle of 70 feet in diameter and the height is about 70 feet. By the admission of water into a tank extending over the whole area of the pontoon, the immersion is increased, thus affording a large margin of stability in rough water.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Bombay, May 26 1887.

As a temporary arrangement Mr. A. E. Hight, Assistant Engineer, 1st grade, on return from furlough, is appointed to act as Executive Engineer for Irrigation, Khandesh.

N.-W. P. and Oudh, May 28, 1887.

Buildings and Roads Branch.

Babu Brijput Rai, Assistant Engineer, 1st grade, is, on return from furlough, posted to the 2nd Circle, Provincial Works.

With reference to Notification dated 10th January 1887, appointing him to the 3rd Circle, Provincial Works, Babu Chandu Lall, Apprentice Engineer, is posted to the Benares ExecutiveDivision.

Irrigation Branch.

With reference to Notification dated 17th May 1887, posting him to the 2nd Circle, Irrigation Works, Babu Bidhu Bhusan Biswas, Assistant Engineer, 1st grade, is posted to the Bhognipur Division, Lower Ganges Canal.

Burma, May 21, 1887.

With reference to *Burma Gazette*, Public Works Department Notification, dated the 29th October 1886, Mr. H. G. Billings, Assistant Engineer, 2nd grade, temporarily attached to the Burma State Railway, is re-transferred to the Provincial Establishment and posted to the Pegu Division.

With reference to *Gazette of India* Notification, dated the 11th April 1887, Mr. A. T. Chiodetti, Assistant Engineer, 2nd grade, reported his arrival at Rangoon on the afternoon of the 14th instant, and his services are placed at the disposal of the Manager, Burma State Railway.

Assam, May 28, 1887.

Rao Sahib Matadin Sukul, M.A., Apprentice Engineer, who was transferred to the Sylhet District in Orders dated 5th May 1887, reported his arrival at Sylhet on the afternoon of the 16th May 1887.

India, May 28, 1887.

Major W. H. Coaker, R.E., Executive Engineer, 1st grade, Deputy Consulting Engineer for Railways, Madras, is appointed to officiate as Consulting Engineer to the Government of India for Guaranteed Railways, Calcutta, during the absence of Colonel C. H. Luard, R.E., on leave, or until further orders.

Colonel K. A. Jopp, R.E., Executive Engineer, 1st grade, and Deputy Consulting Engineer for Railways, Bombay, on return from furlough, to officiate as Deputy Consulting Engineer for Railways, Madras, *vice* Major W. H. Coaker, R.E.

The services of the undermentioned officers are placed at the disposal of the Indian Midland Railway Company.

Mr. H. L. Monk, Executive Engineer, 1st grade, State Railways.

Mr. L. G. Prickett, Executive Engineer, 4th grade, temporary rank, State Railways.

Mr. W. D. Barrow, Assistant Engineer, 1st grade, State Railways.

Lalla Fakir Chand, Assistant Engineer, 2nd grade, State Railways.

Mr. G. A. Campbell, Executive Engineer, 3rd grade, North-Western Provinces and Oudh.

Mr. W. E. Meares, Executive Engineer, 3rd grade, North-Western Provinces and Oudh.

Director-General of Railways.

Babu Bhoobun Mohun Bose, Executive Engineer, 3rd grade, sub. *pro tem.*, is granted leave on medical certificate for five months and six days, with effect from the afternoon of fifteenth December 1886.

Biluchistan.

Mr. W. H. King, Executive Engineer, 2nd grade, 4th Division, Frontier Road Circle, is granted one year's furlough under chapter V. section 50, Civil Leave Code, with effect from the date he may avail himself of it.

Madras, May 25, 1887.

The following intimation, received from the Secretary of State, is published:—Mr. B. H. Young, Assistant Engineer, 1st grade, Madras, four months' extraordinary leave (m.c.) without pay.

The following promotion is made:—Mr. F. W. Ashpitel, from Assistant Engineer 1st grade, to Executive Engineer, 4th grade, temporary rank, with effect from 15th May 1887.

The services of Captain C. H. M. Kensington, R.E., Executive Engineer, 2nd grade, are, on his return from furlough, placed at the disposal of the Government of India in the Foreign Department for employment in Mysore.

Mr. W. L. Bird, Assistant Engineer, 1st grade, resigned his appointment in the Public Works Department, with effect from 18th April 1887.

Mysore, May 21, 1887.

Mr. C. T. Dalal, Executive Engineer, Tumkur Division, is granted privilege leave for 10 days in extension of that sanctioned in this Office Notification of the 8th March 1887.

Mr. A. R. Natesan Sastri, Assistant Engineer, attached to the Ashtagram Channel Division, has been granted privilege leave for 29 days from 28th March to 25th April 1887, both days inclusive.

Mr. F. G. McLaughlin, Assistant Secretary to the Government of Mysore, Public Works Department, is granted privilege leave for two months, with effect from the 1st instant, or date of departure.

Central Provinces, May 28, 1887.

Mr. C. S. R. Palmer, Assistant Engineer, 1st grade, who has completed a course of practical training in England, reported his arrival at Bombay on the 12th current. Mr. Palmer reported his arrival at Nagpur, to which Division he is posted, on the forenoon of the 18th idem.

Punjab May 26, 1887.

Irrigation Branch.

Mr. H. V. S Baker, Executive Engineer, 3rd grade, from the 2nd Division, Bari Doab Canal, which he left on the forenoon of the 1st May 1887, to the 4th Division, Sirhind Canal, which he joined on the afternoon of the same date.

Mr. C. E. Day, Executive Engineer, 3rd grade, from the Karnal Division, Western Jumna Canal, which he left on the forenoon of the 25th April 1887, to the Delhi Division, Western Jumna Canal, which he joined on the forenoon of the same date.

With reference to Government of India, P. W. D., Notification, dated 28th April 1887, Mr. F. W. Schonemann, Apprentice Engineer, reported himself for duty to the Joint-Secretary to Government on the forenoon of the 4th May 1887. He was attached to the Secretariat office on special duty for the 4th and 5th May, and was then posted to the Chenab Canal Division, which he joined on the afternoon of the 6th idem.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

The 16th May 1887.

13 of '87.—John Saxby and John Stinson Farmer, of the Firm of Saxby and Farmer, of Canterbury Road, Kilburn, in the County of Middlesex, England.—*For an improvement in supporting guides for rods to work railway points, signals, gates, and the like.*

80 of '87.—Cottlieb Daimler, of Cannstadt, Wurtemburg, in the Empire of Germany, Engineer.—*For apparatus for effecting marine propulsion by gas or petroleum motor engines.*

Notices.

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subcriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Obituary.

TAYLOR.—At Narasanapett, Chicacole Taluq, on 22nd May, H. W. Taylor, Engineer of Parla Kimidi, aged 39 years.

INDIAN ENGINEERING.

SATURDAY, JUNE 11, 1887.

THE PENSION QUESTION.

OUR readers will probably remember that some time ago, (on the 26th February 1887,) a question was put in the House of Commons regarding the pensions paid to the members of the Uncovenanted Services in India. The terms of the question and the reply were as follows:—

Mr. King asked the Under-Secretary of State for India whether he could state the total amount of pensions paid in England for Indian services during the past financial year, distinguishing the totals paid respectively to retired covenanted civilians, military officers, and officers of the uncovenanted service; whether the pensions of Indian covenanted civilians and military officers were fixed and paid in sterling currency; whether all uncovenanted service pensioners drawing their pensions in England were paid in rupees at the rate of Exchange fixed between the Treasury and the Secretary of State; and what was the total sum in rupees of uncovenanted service pensions paid in England during the last financial year.

Sir J. Gorst, in reply, said that the total amount of pensions paid in England for Indian services in 1885-86 was £2,032,905, made up thus:—Convenanted civilians, £428,817, military officers, £1,459,593, officers of the uncovenanted service, £81,219; others (*i.e.*, High Court Judges, Indian navy, Bengal pilot service), £63,276. The pensions of covenanted civilians and military officers are fixed and paid in sterling currency, uncovenanted service pensioners who elect to draw their pensions in England are paid at the rate of Exchange annually fixed between the Treasury and the Secretary of State, except in a few cases in which pensions fixed in sterling have been specially granted. Excluding these special pensions, the total sum in rupees of uncovenanted pensions paid in England during 1885-86 was Rs. 9,20,000.

Now it seems to us, that the reply given by Sir John Gorst is the strongest argument that we have yet come across in favour of giving sterling pensions to all the services under the Government of India. For instance, in 1885-86 the Treasury rate of Exchange was 1s. 7½d. The total of pensions paid in England in rupees was Rs. 9,20,000, which sum at the rate of Exchange would amount to £73,792, resulting in a saving to Government of £18,200. The total of all pensions for Indian services is more than £2,000,000, so that Government in 1885-86 gained *less than one per cent* by paying its uncovenanted servants at the current rate of Exchange, instead of at par.

The obvious answer to any argument in favour of sterling pensions is, that if they be granted, many more officers will come forward to take advantage of them, so that a large loss would result to the State if any change were made. To this we can only reply, that in the first place the great majority of uncovenanted servants cannot claim a pension, (*except on medical certificate* that they are no

longer fit for Government service.) until they have put in 30 years' actual service over the age of twenty-two, or unless they are retired from their duties at the age of 55 years. It is hardly necessary to observe that very few men live to put in 30 years' service in this country, and this fact gave rise to a well remembered remark in an article in *Fraser's Magazine* on Public Works Reorganization in India; "The officers of the Public Works Department never retire—*they die*."

Another reason which might be urged against the present system is that Government has often expressed its conviction of the unnecessary cost of the European Establishments in this country, and the desirability of substituting cheaper Native agency in their place. We hear that Colonel Filgate is convinced that the Public Works Department could be reduced by one hundred men without detriment to the service. There are many who would go tomorrow, if they had just the difference between Rs. 5,000 and £500 to live on in addition to their rupee pension. We mean men who are entitled to go under the more favourable 20 years' rule, on account of having been appointed from England by the Secretary of State. Surely if establishments have to be reduced, and native agency adopted as far as possible, it is cheaper to pay a man £400 or £500 a year in England, rather than keep on a jaded, enfeebled old horse in this country, dragging unwillingly at his collar, on a salary of Rs. 1,000 to Rs. 1,500 a month. We know for a fact that there are many such men who would go if they could, and whose only fear is that they may be forced to put off the day of retirement till too late.

Take for instance the position in which a man finds himself when he is near the end of his service in this country. He is in nearly all cases a married man, with a family. If he has sent his family home at the proper time, *i.e.*, when still young, we defy him, as a member of the handsomely paid U. C. S., to have saved anything considerable. When he would like to retire, say at the age of 45 or 50, he finds he has to choose between a pension of Rs. 4,000 or Rs. 5,000 a year and his Indian pay which in the P. W. D. would probably be something between Rs. 1,000 and Rs. 1,500 a month. Furthermore, every one of those rupees may be worth in England anything between 1s 2d and par, so that he does not know what his income may be within say 30 per cent. The present outlook is so gloomy, that we can see no reason to prevent Exchange going down as low as 1s 2d to 1s 2½d., since silver can be produced and minted at a profit at the latter rate.

One inevitable result of all this is, that in the Uncovenanted Service, including the Public Works and the Telegraph Departments, men cannot afford to retire. Many, who having private means could do so, are prevented by the twenty years' rule not having been made applicable to all. The net result is a terrible block in promotion, causing discontent from top to bottom of the services. The officers at the head are dissatisfied because they want to go and cannot, those at the bottom because they remain stationary and without hope of advancement. We know for a fact that there are men in the Railway Branch of the Public Works Department, who have been 9½ years in the service, and are still first grade Assistant Engineers, although they entered the service in the second grade of Assistants. But so long as either sterling pensions are not granted, or a limited rate of Exchange for pensions is not fixed, we fear there is no hope for improvement. And the shoe pinches in just the same way in every one of the services which have the misfortune to be what is called Uncovenanted.

PROPOSED RAILWAY EXTENSIONS.

In a recent issue of this Journal we had offered some adverse criticism on Mr. Jeans' paper read before the members of the East Indian Association, violently attacking the Indian Government for their apparent neglect in the matter of encouraging railway enterprise in this country.

We had then conclusively shown that this senseless clamour for extended intercommunication by steam was productive of more harm than good, inasmuch as it overlooked the main point at issue. Our contention was not that there was altogether no room for improvement in that direction, but that until the necessity for a railway was placed beyond the pale of doubt, it would be absurd to launch a scheme on the mere probability of its proving remunerative some time in the distant future.

To count the chickens before the eggs are hatched is the reverse of practical experience. To run a line through an unknown tract of country which offers little or no inducement to the capitalist merely on the hypothesis that it *might* stimulate trade, is not just the sort of venture in which he would wish to sink his funds.

There have been instances on record when a demand has been created by an unforeseen combination of favorable circumstances, but they are few and far between. In order to minimise the risk some of the elements of success must be present there. But these elements are unfortunately absent when a railway project is floated without calculating the returns. Each case must be governed by its attendant facts, and when the chances of success are apparent we would be wanting in our duty not to give the subject a careful consideration. We are, therefore, glad to learn that the surveys in connection with the proposed Patiala-Bhatinda line have been almost completed and the details will be worked out before long. There are no engineering difficulties to be overcome, and taking into account the existing facilities for the laying down of the permanent way and the building of comparatively a few stations, the construction ought to occupy a short period. The Patiala State is to be congratulated for adopting the initiative in an undertaking which will materially help to develop its resources, at the same time that it will prove a source of direct income to the treasury. Here is an instance of what Western civilization has been able to effect towards educating the feudatory principalities in the matter of profitably investing their *talent* for the public good instead of placing it between the folds of a napkin and bequeathing it to be squandered away in frivolities.

A contemporary suggests that while the Patiala Darbar is about this business it might as well extend the line from Rajpurah to Kalka, thus bringing Simla within an easy distance of the plains. We regret our inability to recommend this portion of the scheme. It has too much of local selfishness to find favor with any but a limited section of the community intimately interested in the annual exodus to the Indian Capua. We shall not stop to discuss here all the questionable benefits likely to result from the construction of the line. Suffice it to say that the comparison instituted between it and the Darjeeling railway is a most unhappy one. Our contemporary says: "That mountain railways in India are not altogether impossible speculations, even from the financial point of view, would appear from the fact that the Darjeeling-Himalayan shares of Rs. 100 are at a premium, and the dividends for the last two or three years have been close upon 6 per cent. The last quotation shews a dividend of 6 per cent. exactly with the shares quoted at 103." We do not question the correctness of the figures, but the inference drawn therefrom is misleading. Darjeeling is the centre of one of the greatest industries in India and it would not surprise us to find the shares going up still higher and yielding a handsomer return in future. Could the same be said of Simla? The latter has nothing to send down to the plains, and the only plea for a railway line connecting the two will be found in the convenience of the Government officials who summer there.

While on this subject we might as well refer to the movement set on foot in Karachi in connection with the extension of Railways in Sindh. The Chamber of Commerce have addressed two letters to Colonel Conway-Gordon, Director-General of State Railways, and Colonel Wallace, Director of the North-Western Railway, in which they express their alarm at " the very serious diversion of the traffic with the south-eastern portion of the Punjab which has followed the opening of the Rewari-Ferozepore Railway, joining the Bombay and Baroda system." They contend that Karachi is the natural port of the Punjab, and the drawing off of any portion of its traffic towards the western coast is generally prejudicial to the interests of that Province as well as of Sindh. It appears that sometime back the Chamber had recommended the construction of a line from Bhawalpore to Bhatinda or Sirsa, which would greatly relieve the flow of traffic to Karachi, avoiding the circuitous and expensive route by which the produce of the tract of line lying between Ferozpore and Sirsa was forwarded to the capital town in Sindh. But as there were other important lines engrossing public attention the suggestion was shelved. It should here be premised that originally the project was recommended solely on military reasons, and not, as now, on commercial grounds. Colonel Staunton to whom the results of the surveys made in 1878 were submitted, thus expresses himself in the Administration Report of 1881-82:—" It is well known that such a line could not be a success commercially, as the country throughout is poor, and a great deal of it absolute desert." We are therefore justified in saying that a line through the desert will not pay, and should not be undertaken whatever value it may possess from a strategic point of view. " The physical disadvantages of the route," says a Bombay contemporary, " too, are not slight. It would seem discourteous to the enterprising people of the desert towns to echo the judgment that was passed upon it not long since by an eminent official in the P. W. D., that it is an impossible route. But the deep sand east of Umarkot, shifting and banking up with every storm, and likely any day to cover the railway, is a difficulty that would have to be reckoned with, and one that a railway engineer would rather avoid than endeavour to overcome."

NAVIES OF THE WORLD.

THE rage for heavy iron clads seems on the wane, and the navies of the world are now seriously considering whether or not it would be advisable to substitute high speed cruisers fitted with small guns and torpedoes, but without the protective armour with which the former class of vessels are provided. There appears to be a growing belief that such vessels are of urgent necessity, for the protection or defence of our mercantile marine in times of international warfare. In this opinion shared by those best able to judge, we concur, and while doing so we cannot lose sight of the great risk that these vessels would run in the event of their encountering an enemy's iron clad or falling under its fire. Surely it is not contended that speed will make up for the deficiency of the protection offered by the heavily armoured and mounted iron clads? We shall be curious to know how the following objections, which have presented themselves to us in regard to these lightly armoured cruisers are meant to be overcome by the advocates of this class of vessels—(1) In the event of an encounter with an enemy's vessel how is it intended to escape a total wreck or destruction? (2) Is it really seriously believed that mounted as these cruisers will be with 5″ guns and torpedoes they will be a match with an iron clad or even a heavily armed merchant vessel? We trow not.

TRANS-CASPIAN RAILWAYS.—Two applications on the part of private companies have, it is stated, been made within the last few months to the Minister of Railways in Russia for permission to extend the Orenburg Railway in the Kirghiz region. Of the alternative schemes, one is for carrying a line from the Toliminsk station, on the Orenburg Railway, to Uralsk, a distance of one hundred and fifty miles, and the other to the same spot from Pokrova, on the Volga, opposite Saratoff, a distance of 250 miles. In either case the line would traverse what is described as a flat and fertile steppe, and the cost would probably not exceed £3,000 per mile. The Russian authorities are reported to be giving the matter their serious attention, and there seems little doubt that one or other of the projects will be put in hand. Before long, indeed, we may expect to hear of the European railway system having penetrated to Tashkend and Samarkand, thus opening out the heart of Central Asia, which Russia finds such unprofitable territory at present.

Notes and Comments.

BENGAL-NAGPUR RAILWAY.—The Board of Directors of the Company are calling for tenders for steel transverse sleepers and steel Vignoles rails. The "order" is for 100 miles of "permanent way," and we notice that it is issued by Mr Robert Miller as "Managing Director."

MR. J. C. VERTANNES.—This Superintending Engineer, who is in charge of the South-Western Circle, Bengal, has, we are informed, decided to remain in India another year before retiring on pension. We are glad to hear that Mr. Vertannes has quite recovered from his recent illness.

THE GUJRAT COAL AND IRON COMPANY, LD.—The concessions asked for by this Company having been refused by the Governments of Bombay and India, as well as the Secretary of State, it is deemed inexpedient to carry on the business of the Company, and it is, therefore, to be wound up voluntarily.

MAJOR GRACEY, R.E.—We observe that the designation of this officer is now "Secretary to the Chief Commissioner in the Public Works Department for Upper Burma." The film of disguise under which his transfer was effected from the N.-W. P. is thus laid bare, and a special appointment converted into a general one.

ENGINEERING APPOINTMENT.—Mr. John Kyle, Civil Engineer, lately of Colombo, has just been appointed by the Cart Navigation Trustees to the post of Resident Engineer upon the improvement and harbor works which are now in progress on that river from the designs of Messrs. Miller and Bell, Civil Engineers, Glasgow.

CONTRACT FOR ANOTHER "P. AND O." LINER.—It has just been stated that the Peninsular and Oriental Steam Navigation Company have placed in the hands of Messrs. Caird and Co., Greenock, an order for a new steamer to take the place of the *Tasmania*, which was recently wrecked off the Island of Corsica. The dimensions of the new steamer will be: Length, 400ft.; breadth, 48ft.; depth, 30ft. 9in.

THE NIRA CANAL.—We find that we were out in stating that the expenditure on this important work was "still *four* lakhs of rupees yearly," whereas that figure is the yearly *average*. The expenditure during the past year, owing to financial pressure, was a little over *three* lakhs of rupees, but formerly as much as five to six lakhs have been spent in one season, which accounts for the "average" mentioned.

THE ABT RACK RAIL SYSTEM.—Mr. Abt has received an order from the Indian Government for seven miles of railway, with a three bar rack, switches, entering rails and engines complete. The line will be on the 5ft. 6in. Indian gauge. The engines are to be of the heaviest type, and the first one is to be shipped ready for use from Antwerp by 25th August. Mr. Abt has prepared some intersting data respecting the wear of the rack bars and pinions.

THE BENGAL-NAGPUR RAILWAY.—Mr. T. R. Wynne, Engineer-in-Chief of the Bengal-Nagpore Railway, is now at Simla, but may be expected in Calcutta after the lapse of a few weeks. Mr. Wynne is at present the guest of Sir Theodore Hope, with whom he is elaborating certain details regarding establishment, &c., before commencing operations. It is probable that the point of junction with the East Indian Railway will be definitely settled when Mr. Wynne comes to Calcutta.

RAILWAYS IN BENGAL.—The new length from Rajbari Station on the Eastern Bengal Railway to the River Ganges terminus was passed and opened on Tuesday last. It was feared that the recent heavy rain storms would have damaged the new bank considerably, but it appears to have stood better than was expected. Portions of the new line from Munihari to Kusba on the Assam-Behar line have however been seriously injured by the downfall, and the speed has had to be considerably reduced in places. The Purneah mail train was never a Flying Dutchman at any time; the dak runners could walk round it now.

RAILWAYS IN PERSIA.—The German Government has appointed a permanent consulate in Persia, and hopes thus to favor the trade with that country. Several projects have been made for railways, as a line from the Persian gulf to the interior would prevent the monopoly of Russia's railway system in Asia; thus far all concessions have been refused, but it is hoped the Persian Government can be convinced of the importance of railways. Reuter's project was for a line from Resht, on the Caspian sea, through Teheran, Ispahan, and Shiraz to Bushir, on the Persian gulf, but so many privileges were asked that the Persian officials defeated the scheme.

DERA GHAZI KHAN-PISHIN ROAD.—Somebody cannot help expressing surprise that the part of this road which runs through dangerous and disturbed country is being made and surveyed by Civil Enginneers entirely. It is surely a wrong system that Civil Engineers should have to be guarded at all, and more especially in the case of a strategic work. It would appear to the average outside mind that any work, the danger of which necessitated an armed escort of large size, should be entrusted to the able hands of the Royal Engineers who, as the less favored Civil Engineer is frequently reminded, "receive a higher rate of pay on account of the risk to life and limb entailed by military duty."

OPENING OF A NEW BRIDGE. The foundation-stone of a new bridge to be built over the river Hiranya-Keshi at Ajra in the Kolhapur State, and named the Victoria Jubilee Bridge, was laid on Tuesday, 24th May, in commemoration of the Jubilee year. The bridge is to be built on the road over the Hiranya-Keshi and will consist of five spans, each 50ft. wide, built entirely of masonry, at an estimated cost of Rs. 86,662, out of which the Kolhapur State will contribute Rs. 50,000, the remainder being borne by the Inchalkaranji State, through whose territory runs the greater portion of the road. It is expected that the Jubilee Bridge will not be long in building, as Mr. Shannon is the Engineer.

"SIND-PISHIN" HONORS—AGAIN!—The *Pioneer* of Monday last, the 6th instant, has another leader on the want of recognition on the part of Government of the services of General Browne and the Sind-Pishin Railway staff, and remarks that this cannot be unintentional. The Allahabad paper then goes on to describe the work as perhaps "the greatest piece of engineering yet done in India." This is all really too absurd. The public are now pretty well informed as to the extravagance, waste, and blundering which have occurred on this line, and so far from being unintentional we feel certain that the real reason of the silence of the Government of India is a feeling that "the least said the soonest mended." The sooner much about this work is forgotten, the better for the credit of the Public Works Department.

THE IRRITY BRIDGE ON THE MALABAR FRONTIER.—In

our first issue we described the "Whipple-Murphy" iron bridges introduced by Mr. Anderson for District Works in Malabar with special reference to the Irrity and Merumpoya rivers. A correspondent, who has seen the bridge over the former, asserts that the girders erected are "patterns of neatness, lightness and strength." The Irrity Bridge attracts additional interest from the fact that it was Mr. Anderson's observations on the Irrity river that enabled him to point out that water due to rain, which was gradually finding its way to the river, and the increased activity of the springs, contributed very considerably to floods, and he estimated the increase from these two sources as sometimes reaching "30 per cent. of the whole abnormal flood discharges." When the country was in a saturated state he found that about 90 per cent. of a heavy downpour of rain came down the river.

THE HUGHLI ("JUBILEE") BRIDGE TRAFFIC.—The East Indian Railway authorities at home are, we believe, somewhat exercised at the comparatively insignificant amount of traffic passing over the Jubilee Bridge at Hughli since its opening. The Directors have in consequence issued instructions that a local service is to be established, running from Howrah to Sealdah, and back. It is doubtful if such a service will prove remunerative, as the East Indian will have to pay the Eastern Bengal Railway Co. Rs. 2 per train mile, together with 50 per cent of the receipts. It may suit some Hughli and Chandernagore passengers to be put down at Sealdah, but there would be no corresponding advantage to Barrackpore passengers to be carried up to Naihatty to reach Howrah. The service may develope some intermediate traffic, but we cannot conceive that it would be appreciable. At present the traffic over the Bridge is confined to one or two coal trains a day, and until the Calcutta Docks are completed, there is no great probability of its being largely increased.

CALCUTTA CEMETERIES.—The Cemetery question is still to the fore in Calcutta, and the extension of the Circular Road Burial Ground, and other questions connected therewith, will now be referred to a Committee consisting of Mr. H. J. S. Cotton, Colonel Neill, Mr. Forbes, Collector of the 24-Pergunnahs, Rev. J. H. Taylor, Rev. Mr. Gillan and others. The residents in the neighbourhood, who object to the extension, will also, as is only right and proper, be represented on the Committee. We would again urge on the Burial Board the desirability of establishing a *crematorium*, so as to give persons who desire to dispose of their bodies in a cleanly way a chance of doing so. The present Chairman of the Board is said to be in favor of this proposal. Meanwhile the Mahomedans, who are badly pressed for burying space, are beginning to justly object to the laying out of Government money on Christian Burial Grounds only; asserting that they have an equal right to be considered and that proper cemeteries should be provided for their community as well as for Europeans.

THE SUTLEJ BRIDGE AT FEROZEPUR.—Supplementary to what has already appeard in our issue of the 30th April, the following is a brief description of the bridge, which has been constructed on a design prepared by Mr. R. T. Mallet, M.I.C.E. The total length over all is 4,250 feet, comprising 27 spans of 150 feet girders, supported on piers, with well foundations sunk to an average depth of 80 feet, below the bed of the river. The height of rails above the low water level of the river is 26·5 feet. The girders are partly of steel and partly of iron. The Railway track is on the lower boom of the girders, and an overhead roadway is provided for cart traffic. A special feature in connection with this bridge is the extensive system of river training works that have been constructed as a part of the undertaking. These have been formed on both banks of the river, over a distance of nearly 3 miles upstream from the bridge, and consist of earthen bunds and spurs protected by heavy pitching. By these works the course of the river is controlled and the flood channel gradually confined, till at the bridge site it is limited to the width between the abutments. The successful execution of these works has only been arrived at by much skill and care and perfect arrangements in the supply of material, &c.

THE PUBLIC WORKS DEPARTMENT OF UPPER BURMA.—Subject to confirmation by the Government of India, the Chief Commissioner has sanctioned the formation of the following Public Works divisions in Upper Burma, namely:—I.—The Meiktila Division, which will embrace all public works within the districts of Meiktila, Yamethin and Pyinmana. II.—The Taungdwingyi Division, which will embrace all public works within the district of Taungdwingyi. III.—The Minbu Division, which will embrace all public works within the district of Mimbu. IV.—The Myingyan Division, which will embrace all public works within the districts of Myingyan and Pagan. V.—The Mandalay Civil Division, which will embrace all public works within the districts of Mandalay, Kyaukse and Ava. VI.—The Chindwin Division, which will embrace all public works within the districts of Chindwin and Sagaing. VII.—The Shwebo Division, which will embrace all public works within the districts of Shwebo, Katha and Ye-u. VIII.—The Bhamo Division, which will embrace all public works within the district of Bhamo. IX.—The Ruby Mines Division, which will embrace all public works within the Ruby Mines district. X.—The Mandalay Garrison Division, which will embrace all public works in the Cantonment of Mandalay.

A WAIL FROM BENGAL.—The "Wail from Madras," which we animadverted on in our last number, has also a local habitation in Bengal. Nothing will satisfy a passed student in Engineering, whether from Seebpore or the Presidency College, except an appointment under Government. The prestige of serving the State, we imagine, outweighs any advantages to be obtained by working as an "outsider." Accordingly, the Bengal students are memorialising the Government of India, and clamouring for admission to the Public Works Department. We were rather amused to hear the other day that one of the most prominent memorialists is a Bengali gentleman who has served Government for several years, and was afterwards provided with a good appointment under the Port Commissioners, through the influence of the officers under whom he had worked. And yet he is not happy! The late Chief Engineer of Bengal was one of the best hearted men in the world, and very kindly disposed towards his native subordinates; in fact, it was quite impossible to induce him to inflict punishment in several cases which came up during his time, Bengal was a bed of roses for the Native Engineer, but it is open to doubt whether such halcyon days will last for ever, or even for any length of time. Still there is unquestionably a feeling that it is better to take small pay in the Department, with a pension after 30 years' service, than work outside it with far better prospects. Perhaps *izzat* has something to do with it.

Current News.

COLONEL POTTINGER, R.A., becomes Military Secretary to the Bombay Government.

THE East India Exploration Company's property is said to cover the whole of the Honnali gold fields.

MR. RIBBENTROP, the Inspector-General of Forests, shortly goes on furlough. Major Bailey probably acts for him.

THE Toungoo-Mandalay Railway is progressing favorably, and it is hoped the surface line will be concluded by June next year.

MAJOR SARGEANT, R.E., who arrived from England by the last mail, has taken over charge of the Eastern Bengal Railway system.

AN unprecedented fall of rain is reported from Serajganj, in Eastern Bengal, on the 1st instant: ten inches fell between 4 A.M. and mid-day.

THE Pontoon Bridge over the Western Ferry, which is a boon to travellers, has, after all, received the sanction of Government, and is now in a fair way of erection.

A SMALL party of Bengal Sappers and Miners shortly proceed to Lundi Kotal in the Khyber Pass, in order to arrange for the construction of a fortified post there.

THE idea of transferring the management of the bridge-of-boats over the Indus at Dera Ismail Khan, from the Civil to the Public Works Department, has been abandoned.

IN reply to an inquiry from the Government of India, the Calcutta Corporation has declined to undertake to further in any way the objects of the Imperial Institute.

THE difficulty of providing carriage and supplies for military purposes along the new Dera Ghazi Khan and Pishin Road has been under recent consideration by the Government.

THE alignment settled by the Government surveys for the Bengal-Nagpur Railway will be adhered to, but the point of junction with the East Indian Railway has still to be decided on.

LIEUTENANT COLONEL H. R. THUILLIER, R.E., Officiating Surveyor-General of India, is confirmed in that appointment, with effect from the 19th February last, *vice* Colonel G. C. DePrée, S.C., deceased.

EIGHTEEN months ago the re-armament of the Artillery in India was admitted to be a crying necessity, but the Home authorities in spite of prodding have not got much beyond the admission.

FINAL orders have, it is stated, now been passed for the closing of the gunpowder manufactory at Madras, notwithstanding the remonstrances of the local Chamber of Commerce and the Madras Government.

THE employés of the East Indian Railway who struck at Jamalpore have been fined various sums, from fifty rupees downwards, for leaving work without giving the customary fifteen days' notice.

ALTHOUGH the Railway Kaisar-i-Hind Bridge near Ferozepur has been opened, the upper road, over the bridge, for traffic is not ready yet, and is likely to take long before it is completed, so the country carts and other heavy traffic are being put to great annoyance and trouble.

THE question of the route to be taken by the railway across the Khwaja-Amran range will probably be settled very shortly, as though the final survey reports have not yet been received, the Government is now in possession of sufficient material to arrive at a conclusion.

AT a special general meeting of the Howrah District Board, held on the 25th ultimo, a scheme for the construction of the Steam Tramway from Howrah to Amta, a distance of 28 miles, was approved and forwarded to the Lieutenant-Governor of Bengal for formal sanction.

GREAT activity is displayed in extending the S. N. Railroad from Gubbi and Harihur. The line is quite flooded with Engineers, contractors and coolies. It seems a great pity that the work was not taken up in earnest during the hot weather, when people have so little to do. Now the rains have come, laborers will be scarce.

WE are glad to see that at last there seems to be a chance of the *flêche* being very soon completed at the Lahore Cathedral, but we hear that a scarcity of funds will compel the rest of the work to be stopped at the East end of the building, which still lacks the flying buttresses, which, it was hoped, might have been undertaken this hot weather.

THE application of the Municipal Committee of Peshawur for a loan of Rs. 2,00,000, for carrying out the proposed scheme for supplying the city with drinking water, has been rejected by Government; but Ram Dass, contractor, has offered to carry out the work under certain conditions, which have been submitted for Government approval.

MR. WILLIAM KING, A.B., D.SC., Director of the Geological Survey of India, is granted privilege leave for three months, with effect from the 25th instant, or any subsequent date on which he may avail himself of the leave. Mr. R. Bruce Foote, Superintendent, 1st grade, is appointed to officiate as Director of the Department during Dr. King's absence on leave.

ALTHOUGH the greater part of Rajputana is subject to excessive heat and long periods of drought, the system of irrigation there is rather primitive, the water being drawn entirely from tanks. Still irrigation seems to be remunerative, and the Government is well satisfied with the results of the year's operations, which, it says, is mainly due "to improvements in administration, to careful distribution of water, and to economy in maintenance."

SOME extensive improvements in the European Infantry Barracks at Colaba are in course of being carried out. Permanent barracks are to take the place of the temporary ones. Two new blocks will first be constructed, the character of which may be judged from the plinths already completed—foundations which appear strong enough to form the base of a fortress. These two buildings will differ from all others in Colaba, inasmuch as they will be two storeys in height.

IT having been found that the exigencies of the public service would suffer by the transfer, temporarily, of a railway officer to Madras as Senior Deputy Consulting Engineer for Railways in the room of Major Coaker, R.E., transferred on promotion to Calcutta, the Government of India have decided that his *locum tenens* shall be Colonel Jopp, R.E., who is expected to return from his six months' leave in July next. In the *interim* the office of Consulting Engineer for Railways will be only manned by 2, instead of 3, officers.

AGAIN has Reuter come out with a marvellous and quite unfounded statement on Afghan matters. His matter of fact announcement that English Engineers are fortifying Herat so as to render it capable of standing a siege looks as though his Agent had got hold of some papers of two years ago when our Commission was in Afghanistan, and had mistaken them as having reference to the present. Perhaps he has been merely hoodwinked for a purpose. At any rate, in point of fact, there is no British Engineer officer nearer to Herat than Colonel Sir Oliver St. John at Quetta.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

IN RE DESIDERATA.

SIR,—I hope you will not accede to the third suggestion of "Amateur" in your issue of 28th May, and commence a practical, popular and scientific treatise on strains in lattice girders.

To supply elementary instruction is not the object of an *Engineering Journal*, though discussions on the more intricate points, and the proper relations of theory and practice, are not out of place, but in all such a competent knowledge of the subject is supposed.

F. E. R.

TALC IN PAPER-MAKING.

SIR,—I saw a small paragraph in your Journal a short time ago about the Yankees using "Talc" as a paper finish, that is to say, to give the paper a fine gloss. Now, since then I have been trying to dissolve this substance but have failed. Can you or any of your readers enlighten me on the subject? If so, I should be much obliged. I have an idea it is used after being ground up.

PAPER MAKER.

31*st May* 1887.

TO COLLIMATE A DUMPY LEVEL.

SIR,—In the article "To Collimate a Dumpy Level" there is nothing in it but what most people know. If pegs are used more time is lost in getting them on the same level than would be necessary in making the adjustment in the ordinary way. A careful leveller would not be satisfied with performing the adjustment in this way *once*. "J. C. M.'s" principle will be convenient when a sheet of water is handy, and every surveyor should understand the principle, not that it would save him much, if any, time, but that it would give him clearer views regarding his work.

A. M.

A CORRECTION.

SIR,—Thanks for reviewing my Report in your Paper of the 28th May. I have, however, to correct an error you made in the paragraph regarding His Excellency the Viceroy's gasworks. It is not the *Plant* which I remodelled at less than half the original cost, but the cost of the *Gas* the price of which I reduced by a half. The change cost only something like Rs. 300. All the works had been made under my guidance at the Executive Engineer's Workshops in Simla.

The cost of gas was about Rs. 20, with the old apparatus, whereas it is now Rs. 8 to Rs. 9 per 1,000 cubic feet.

In reference to your remark of not being a financial success, I beg to say that, no charges are made for lighting the City, Palaces, and other public places. The revenue is merely from a few private houses and for products sold, which, I think, you also understood, but from your remarks it would appear to non-professional people that the works were at terrible deficit.

I send you to-day our Annual Reports from the year 1880 which might be of interest. You will find that originally it was a most expensive luxury.

S. J. TELLERY.

SLAVE TRADE.

SIR,—One of the greatest curses we have to contend with, is the Slave Trade, which is carried on in these districts with head-quarters at the *Subdivisional Station Raneegunge.*

All gentlemen of no profession, when everything else fails, turn into what is called by the natives *Cooly Catchers* or in another word *Slave Dealers.* As soon as a gentleman takes to the above profession, all the *budmashes* from the *villages* join him; then licenses are procured for them from the Magistrate to collect coolies under the title "*Agents for Free Labor.*" These people spare no means to work their way among the people of the villages and entice away on the quiet, either men, women or children. If they cannot succeed with quiet *persuasion* they get the coolies drugged in the grogshop and under this influence get them to leave home; then under fear of all kinds they are got before the Magistrate or *Officer for Emigration.* The coolies are so frightened that they can only say what they have been *schooled* to say. After this the *budmashes* reap their reward, what they have been promised by their employers. The poor coolies are sent on their journey, not to get the Rs. 10, 12 or 20 per month, but only about Rs. 5, yet they leave employment where they can get Rs 8.

In places like Raneegunge, Asansol, and Barakar where all kinds of labor is so scarce and hard to be got these agents are allowed to go about by the Police—in fact, the village Police often assist them to get *coolies* away and to trump up cases to frighten the coolies so that they dare not return. I don't think there is a European in the district in charge of works but that has not suffered from this *Slave System.* If all such would represent the affair to the Government, they might do some good and have a stop put to cooly recruiting in those localities where labor is so scarce. Perhaps some of your readers will bear me out in the above matter.

SOOBHA KANKHY,
June 3. Black Country.

Literary Notices.

THE CAMERA.

WE have been favored with some specimen numbers of this *new* Journal, which is a monthly magazine for those who practice photography. It is edited by T. C. Hepworth and published by Wyman and Sons of London. The articles are varied and interesting and the illustrations numerous and good. We can strongly recommend the periodical as a cheap example of that special serial literature which is a feature of the times.

RECORD OF THE GEOLOGICAL SURVEY OF INDIA. May, 1887.

THIS number, which forms part 2 of Vol. XX., commences with a Paper by Mr. Lydekker on the Fossil Vertebrata of India. This is a republication of former articles on the same subject by the same author, with such additions as are necessary to bring it up to the present time. It is hoped that the brief summary furnished by the Paper will enable those disposed to study the subject to grasp the features of the past vertebrate life of India, without the trouble of wading through the bulky literature in which its history is more fully recorded.

Professor Duncan's Note on the Cretaceous Series of the Lower Narbada Valley, which follows, is remarkable for a criticism on certain researches of Mr. P. N. Bose of the Geological Survey in the same *locale.* Professor Duncan disagrees with Mr. Bose's deductions, and says that the latter "writes with great modesty, not unflavored with some critical sharpness, when dealing with his predecessors in the strategraphical part of his work, and he also most straight-forwardly asserts his shortcomings as a palæontologist." We have been induced to give this excerpt as some explanation of what appeared in this Journal in connection with Mr. Medlicott's observations on the employment of natives as Geologists.

Mr. Griesbach gives the fifth instalment of his Field Notes on the Geology of Afghanistan. His Paper is accompanied by a Sketch Map, and from the description given we learn that beds with true carboniferous forms have been found from Araxes in Armenia to Central Afghanistan. They form narrow strips at the base of the older mesozoics, and as such have been traced in a more or less uninterrupted zone along the Central Asian watershed. In some places in Persia they overlie some strata which have yielded fossils of rather devonian than carboniferous aspect, and it is possible that perhaps the entire palæozoic series will be found to exist. The same rocks extend into Russian Turkistan, where they crop up from beneath the covering of mesozoic (chiefly cretaceous) formations. The Paper concludes with the following summary of more than ordinary interest:—

1. The carboniferous group shows great points of resemblance both lithologically and palæontologically, over the entire distance from the Caucasus to the North-West Himalayas. It is a purely marine formation, and pelagic conditions seem to have prevailed in the Caspian region, Northern Persia, Afghanistan, and the Himalayan area.

2. At the close of the carboniferous period began a shallowing of the sea over the greater part of Central Asia, including Northern Persia, and Afghanistan, which more or less continued to neocomian times, when the sea altogether retreated from large tracts of Central Asia, including Afghan Turkistan. During that time littoral deposits were laid down along a coast line which seems to have agreed more or less with the present direction of the Central Asian watershed. In the adjoining areas, of Asia Minor and the Hymalaya, pelagic conditions continued.

3. In upper cretaceous times a great overlap of the sea began and extended to lower miocene times.

4. After the deposition of the lower miocene the sea began to retreat gradually from the coast-lines, not only in the Central Asian area, but also in Sind and Biluchistan, and estuarine and freshwater deposits were being laid down conformably on the marine miocene beds. The retreat of the miocene seas was continued in late tertiary times and in fact the same changes are still proceeding at this moment. In place of the estuarine deposits huge accumulations of freshwater and aërial formations took place over the greater part of Central Asia, Persia, and our Sind frontier.

The remaining articles call for no special notice, except that Dr. Warth expresses the hope in his Paper on the correlation Olive Series on both sides of the Salt-range that in due time something may be found among the Talchirs, or near them to completely establish the truth of Dr. Waagen's more important correlations with regard to the Indian coal measures.

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General Articles.

CALCUTTA PORT IMPROVEMENTS.

THE KIDDERPORE DOCKS.

I.

THE Port of Calcutta, in its situation and nature presents a striking contrast to Madras, the attempts to make which place a seaport are now being considered in INDIAN ENGINEERING. Instead of being on an open straight seacoast, Calcutta is situated some hundred miles from the sea on a tidal river; and, ordinarily, ships lie there in perfect security, and take in and discharge cargo by means of ordinary cargo boats or directly by means of wharves on the bank, without having to risk it all in a surf such as prevails at Madras. And yet Calcutta is far from being a safe port. It is not easy to get into it, and it is not easy to leave it. The River Hughli, on which it lies,—the western channel of the Ganges-Brahmaputra Delta,—is accessible only by carefully threading the channels between the "sands" which it deposits in the Bay of Bengal, and the utmost possible vigilance of skilled pilots, kept informed as to the frequent changes in the shoals and channels of the river itself, and as to the state of the tide by a constantly working surveying establishment, is needed to ensure a vessel reaching port or getting to sea in safety. At certain critical points, with a deeply laden vessel it is literally "touch and go." Should a ship ground there, and not scrape through, she may capsize, and the tide or stream may scour a hole round her that will engulph her in a few hours. And even should no accident happen, a fast steamer, deeply laden, as the present writer can testify, may not get to sea in less than 60 hours. But these are not all the drawbacks to Calcutta, considered as a port. It lies in a path frequently traversed by cyclonic storms, and though vessels caught in a cyclone in the Hughli are not exposed to a sea such as destroyed the Madras Harbour, they are liable to be torn from their moorings by the dreaded "tidal wave" which passes up the river, and then wrecked by the violence of the wind. The phenomenon of the bore in rivers with funnel-shaped estuaries, and tortuous and unequally deep beds, notably the Sittang in Burmah, the Severn in England, and the Amazon in South America is in the case of the Hughli, and other rivers of the Bengal delta greatly aggravated during a cyclone, because the sea is gradually heaped up against the coast by the action of the wind and the local decrease of atmostpheric pressure. How destructive may be the result was proved in Calcutta during the cyclone of 5th October 1864, when many ships broke loose and drifted about till they were sunk by collision with others or left high and dry on the banks. A larger number still was sunk at moorings, being cut down by the drifting vessels, or perhaps swamped by the wave, owing to the limited scope of their mooring chains. Another cyclone passed over Calcutta in 1867, but by that time screw moorings had been laid down, and though the storm was considered by some authorities to have been as severe as the former one, the comparative immunity from loss experienced by the shipping was attributed to this precaution. But hear what the Port Commissioners put on record only two years ago, in their final and triumphing plea for the construction of wet docks at Calcutta:—

"It was the cyclones of 1842 and 1864 which led to the appointment of the two former Committees which recommended the construction of wet docks. Fortunately, Calcutta, for 20 years past, has not experienced a cyclone of the severity of either of these gales. Should such a gale occur, accompanied by a strong tidal influx, there is every reason to apprehend that the result to the shipping of the port would be as disastrous now as in former years. The moorings have been strengthened, but the ship's fastenings have not proved equal to the severe strain to which they may be subjected, as was shewn in 1874, when two vessels broke away and drifted through the Hughli (pontoon) bridge without any damage having been sustained by the moorings. That this positive advantage of wet docks over jetties is important will be apparent from the accompanying extract from the report of the Chamber of Commerce for the half-year ending 31st October 1864, in which the damage sustained by shipping during the cyclone of October 1864, was thus summarised. Lloyds' agents reported to the President of the Chamber the following particulars:—

		Vessels.
There were in the Port of Calcutta on the morning of the 5th October 1886		195
Of these—escaped without damage	23	
" were total or constructive wrecks	36	
" severely damaged	97	
" slightly damaged	39	
	—	195

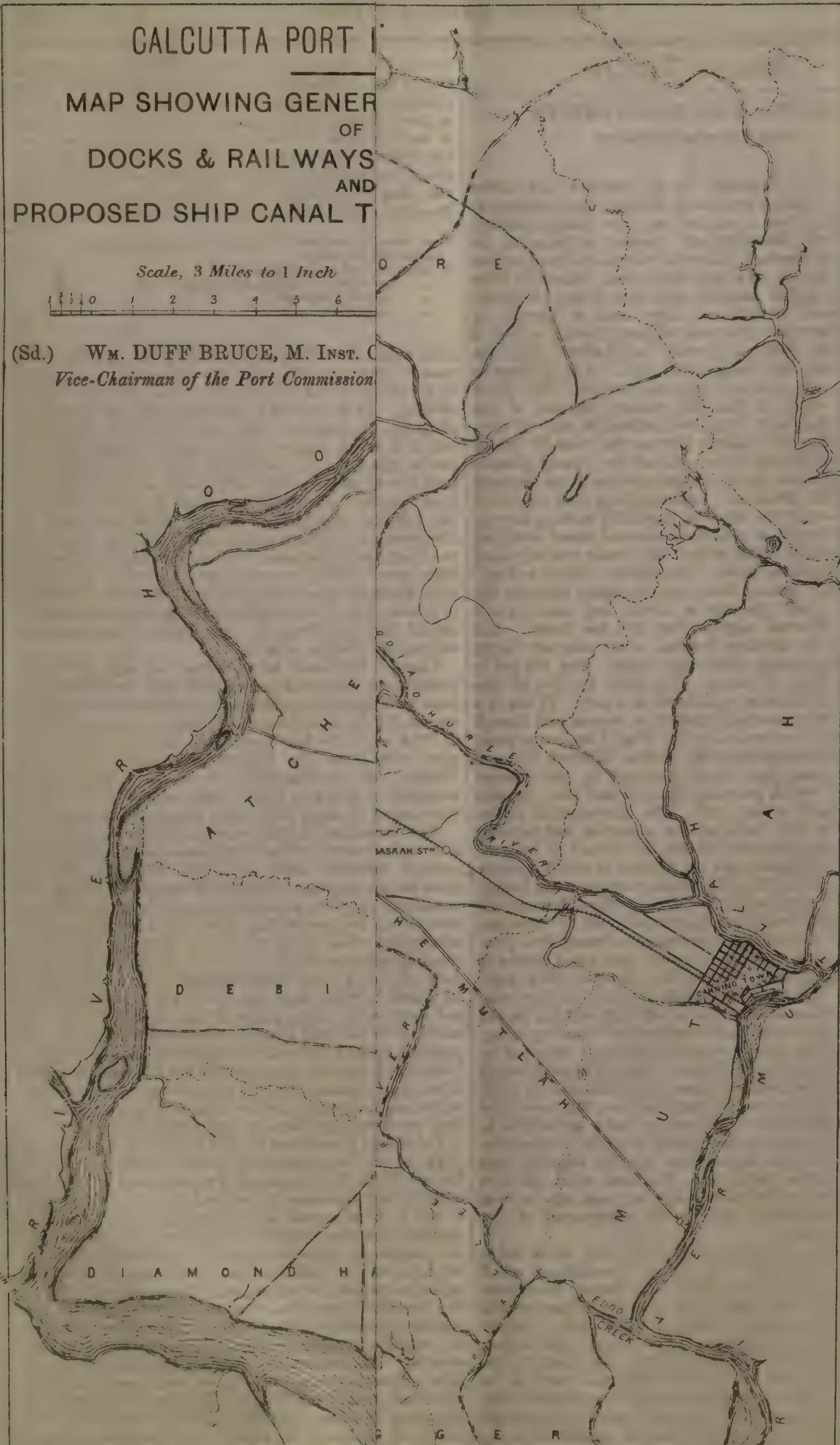
Such were the effects of the last great cyclone which passed over the port, and the estimated cost of which to the shipping was put down by some at two millions sterling. As to the loss on cargo in course of landing or shipping no estimate was ever arrived at. The only article of which proper account could be taken was salt, and in regard to this the official report stated that 'the total loss of salt on ships and boats, as well as swept from *golahs* at Hatkolah, bore a total value of Rs. 9,69,809, the greater part of which was borne by Government.' From a consideration of these facts," say the Port Commissioners, "it is apparent that even if there were on the Calcutta bank of the river sites available, which there are not, for the construction of wharves or jetties, any further extension of port accommodation should take the form of wet docks in preference to additional jetties or wharves."

Though wet docks for Calcutta are only now under construction, proposals for providing such accommodation have been frequently made, at intervals extending over a period of more than sixty years. And even long previously to 1824, when the first Committee appointed by Government considered the subject, it appears that a General Watson, not only designed, but actually began the construction of docks on Tolly's Nála, capable of containing the number of ships which then frequented the port.

The Committee of 1824 were not able to do much, for, after endeavouring without success—perhaps because the interval between their only two meetings was too short for the purpose—to obtain information through the mercantile members as to the amount of saving likely to accrue from the construction of wet docks capable of containing the whole shipping of the port, and after considering and rejecting a plan by Major Schalch for a wet dock at Tolly's Nàla, and discussing a plan by Mr. Colvin for a dock between Meer Bhur Ghât and Nimtollah Ghât, and resolving to obtain a plan of the river, shewing the nature of its bed, and an estimate of the cost of the dock proposed by Mr. Colvin, and of another on another site, they "adjourned *sine die*, on account of the Burmese war, and never again reassembled." This tautology the next Committee are responsible for, for it is their account only of their precursors' proceedings that is published.

The second Committee on Wet Docks was appointed in 1844, by the Government of Bengal, under Lieutenant-Colonel W. N. Forbes, R.E., as President, and at their first meeting they unanimously resolved that the construction of wet docks to contain all the shipping at any one time collected was most desirable and perfectly practicable, and the mercantile members being of opinion that it would be quite safe to calculate on a revenue of 5 lakhs of rupees per annum, which sum was 10 per cent. on 50 lakhs, the Committee considered that the subject of inquiry was practically reduced to the question whether wet docks of the required capacity could be constructed for that amount. The assumption that docks could not be provided unless they would pay 10 per cent. seems to have been made because the Deputy Governor of Bengal had suggested that the enterprise should be entrusted to a joint-stock company, in which the Government would be a considerable shareholder. Pending information

Plate No. 1.



Litho. I. C. Press, Roorkee.

THOS D. ..., Surdt.

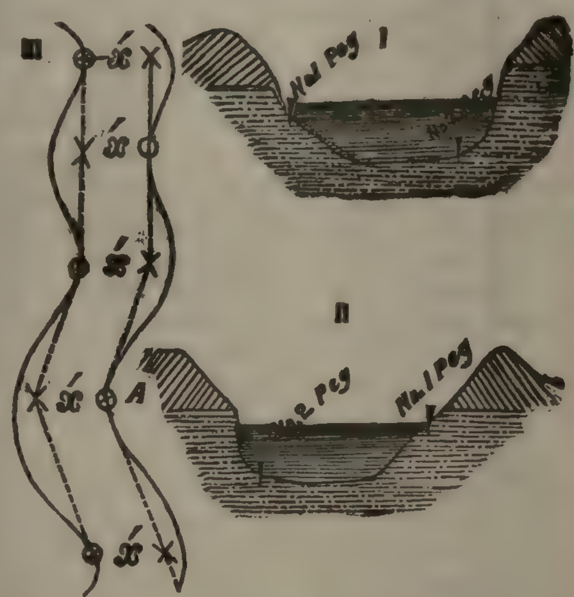
being obtained as to the cost of the works, the Committee proceeded to discuss the site and general design and capacity of the proposed docks. And they referred to the twelve Branch Pilots for their opinion as to whether any permanent deterioration of the Hughli as a navigable river was to be apprehended. This idea was negatived by eleven of the Pilots to one. Later on in the enquiry a suggestion of one of the members, Captain Goodwyn, R.E., that if a Railway were constructed to Mirzapur, with its terminus at Howrah, the docks ought perhaps to be on the Howrah side of the river, was negatived after the opinions of the mercantile members had been taken; and next the site first suggested at Kidderpore, as near to Tolly's Nàla as possible, was rejected because of the cost of the land required and the buildings on it, Rs. 1,100 per bigha, as valued by the Collector, and the preference was then given to a site near Akra, about 7½ miles lower down the river. The Committee, after obtaining returns of the shipping and coasting craft for three years, decided that the docks should be spacious enough to contain 200 vessels of an average burden of 400 tons each, and called upon Captain Goodwyn, who was Civil Architect, to prepare a plan of two docks, export and import, having a water area of 30, and a land space of 20, acres, with sheds, &c. The communication with Calcutta was to be by a double line of railway to Tolly's Nàla, and thence on to town, at a point near the General Treasury,—the railway to be built over scouring drains taking off from Tolly's Nàla, about 5 miles distant. The sill level of the dock gates was to be 8 feet below the lowest low water of a spring ebb-tide. The docks were "not intended to take in the large steamers, as that would considerably increase the expense of construction, by rendering it necessary to have greater width of gates, and even greater area of the docks themselves." This record of the fact that in 1844-46 the average burden of the shipping, exclusive of the large steamers, to be provided for was only 400 tons, and that these large steamers were expressly excluded from the scheme, suggests contrast with the state of things in 1882, when the Diamond Harbour Committee provided for the accommodation of steamers with an average burden of 2,600 tons, and sailing ships averaging 1,350 tons.

Captain Goodwyn accordingly prepared and submitted a plan on the data given him, but the estimate at first amounted to Rs. 70,57,755. By diminishing the length of scour it was reduced to Rs. 55,63,730. Previous modifications of this plan were discussed but rejected, and the Committee were about to report in favor of the original plan, with modifications, which included extending the railway as far as the Custom House, when the President suggested reconsideration of the question of locating the docks at Kidderpore, and, after a lapse of six months, as a plan of the land and buildings, and a valuation of them by Messrs. Burn & Co., shewed that only 498 bighas, valued at Rs. 5,39,000, would be required, the Committee finally and unanimously resolved to recommend the adoption of that site. Captain Goodwyn, therefore, again went to work, and produced an estimate of the cost, which, including all the adjuncts and the railway up to the Custom House, amounted to Rs. 45,70,586. Mr. Murray Gladstone, one of the mercantile members, estimated the revenue at Rs. 6,15,490, and after deducting for establishment, wear and tear, and maintenance of the railway, the sum available for interest on capital was brought out at Rs. 4,50,604, or more than 9 per cent. on 50 lakhs. It was recommended on the suggestion of the President that the railway should be an atmostpheric one, as being cheaper, and less of a nuisance than one worked by steam; and it was shewn that by the addition to the scheme of a branch Custom House at the docks it would be necessary to carry the railway beyond the Esplanade.

In acknowledging the receipt of the final report of the Committee, the Deputy Governor of Bengal (*sic.*) expressed his approval of it, but before taking action on it, directed that it should be printed for the consideration of the community of Calcutta, from whom he invited proposals for carrying out the scheme by means of a joint stock company, or otherwise. Afterwards, at the suggestion of a member of the Committee, the project was referred to Mr. F. W. Simms, Consulting Engineer to the Government of India, who approved of it all, except the proposal that the railway should be atmospheric, for the success of that system was still doubtful.

INUNDATION CANALS.

Lining out in the Annual Clearances.



THE Inundation Canals in the basin of the Indus river are very ancient works, and it is natural that the stranger accustomed to the neatness of the modern canal should speak sneeringly of "*them ditches.*"

Their most obvious defect is their unintelligible crookedness. When the annual clearances are carried on under the old system, the laborers are crowded on and left to their own devices as to how they should remove the silt, so the bends and angles are increased in every successive clearance. Even when one insists that the clearance shall be made to certain level pegs and to fixed widths, it is not easy to instruct the liner-out how to put down the side widths and how to range his line.

For years I tried to teach the liner-out how to range a centre line so as to get rid of some of the minor bends and kinks, but the centre line plan required that liners-out should not only understand diagrams of various classes but have the ability to apply what was taught in long lines of channel. A few did learn, but having no simple precept as a guide often made blunders and often mistook neatness of work and well rounded curves for good alignment.

The instructions about laying down a good centre line were not generally understood and the results were disappointing.

In the last clearances, I abandoned the centre line arrangements and laying out of side widths at equal intervals and arranged that the side widths should be laid out from all the convexities of the channel and the concavities ignored. As in figure 3.

The convexities are locally called "*khōbs*" and the concavities "*dings.*" I found that the order to put the first peg of the side width at the high water mark of every "*khōb*" and lay off No. 2 peg from it and ignore every "*ding*" as in *figs.* 1 and 2 was understood by one and all. The most stupid man could recognise a *khōb*, so the lining out became very simple work.

The sharper men could be easily taught to estimate how much it would cost to shave off a bit of such a *khōb* as A so as to still further improve the alignment.

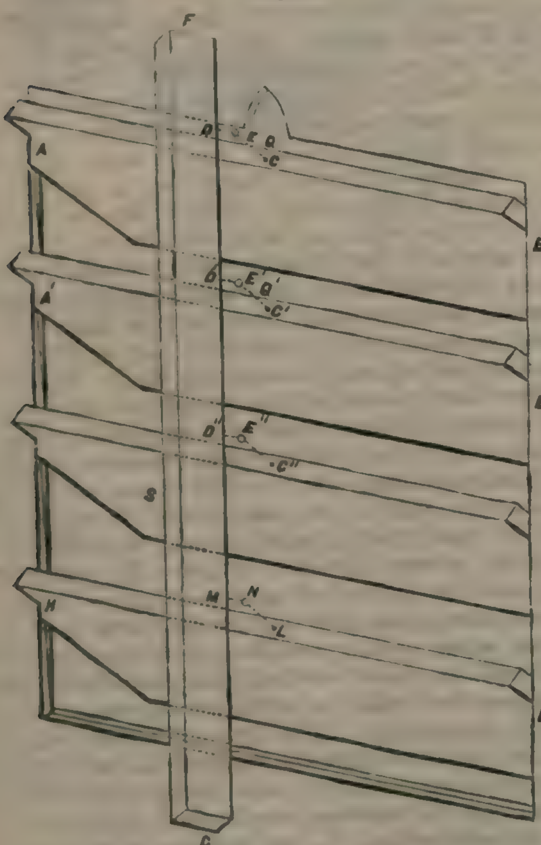
In taking up additional land on these canals it is obvious that the process should be reversed. Having settled the minimum side width necessary this side width should be staked off from every convexity or *ding* of the water section. E. A. S.

THE JHILMILI WINDOW.

By A. Ewbank.

In England we are accustomed to open or close our venetian blinds by the movement of a cord. The Indian arrangement is quite different and as a dynamical problem it is worth study. The reader is advised to examine and use one of the actual jhilmili arrangements in a door or window of his bungalow to complete the imperfect illustration of the actions which are given in the accompanying diagrams. Our diagrams represent only as much of the shape as we have occasion to refer to in considering the movements and forces. We may imagine a jhilmili arrangement which is ideal in two respects. (1) We may suppose the parts to work without friction. (2) We may suppose the thick wood of the actual door or window to be replaced wherever we please by thin laminæ. The thickness is generally only required for strength and we may imagine a window made of something as strong as steel, so that in some cases such as the vertical bar FG of *fig.* 1 we have simply a rectangle long in one direction, narrow in another, and having no appreciable dimension in the third direction. For convenience let *fig.* 1 denote,

Fig. 1.



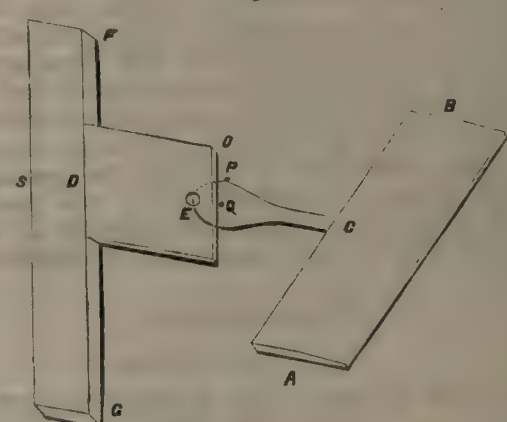
say, one quarter of a window. This quarter has in the drawing four moveable bodies ACB, A'C'B'.......... Each of these we call a leaf of the venetian blind. Let the plane of the window be due east and west. Let the window have a north aspect. Then when the leaves of the venetian blind are as completely closed as possible the plane of the bar F G is the plane of the meridian. The lines D E, D^1 E^1, &c. have directions due north. The leaves when most closed are not quite vertical. If the frame A H K B of *fig.* 1, which holds the leaves had no perceptible thickness—that is, no dimension in the direction due north—and if the leaves were also lamina of inappreciable thickness, then the leaves when closed might be considered vertical planes coincident appreciably with the plane A H K B. This plane we may also consider fixed. That is, we are studying the opening of the venetians and not the opening of the window, as a whole or of any part of the window. A leaf A C B is fixed in bearings at A, B. That is, the leaf can rotate about the east-west line A B and cannot move in any other way. The bar F G could have a variety of motions if it was only fixed to one leaf. But if fixed to several or only fixed to two—and if each lea with its connections to FG is identical with that of any other leaf, then F G must always be parallel to the plane A H K B. The points C, C'......are placed on the middle line of A H K B and F G must always be vertical. Thus F G as a line can never be supposed to rotate about any line unless that line is vertical. Its motion as indicated in *fig.* 4 may, if we please, always be considered one of pure translation. That is, any point of the line F G in *fig.* 4

Fig. 4.

describes the same line straight or curved as does any other point of F G. If F in moving to F^1 describes a path F R F^1 then G must have described an equivalent path G R^1 G^1.

Each leaf is fastened to the bar by connections which are very imperfectly indicated in *fig.* 1. In *fig.* 2 these connections

Fig. 2.



tions are more fully shewn. The *plane* F S G has a prolongation D E O. The shape of this prolongation may be varied. In it is a hole E, which we will suppose a true circle. The lamina F S G O having a definite, though very small thickness, we will assume that the hole E in this laminal is a straight tunnel—that is, a circular cylinder of small radius and *very* small length. Let r be the radius. Then we may imagine a thin round iron rod of this same radius r and of length $2 \pi s$ to be bent round into a ring of radius s. This ring is indicated in *fig.* 2. It is prolonged by a piece of iron that fits into the leaf at C. This ring may be considered, as r is small to lie in a plane and this plane E P C is coincident with the plane A C B, that is, A C B and C P E may be considered as cut out of one and the same flat lamina. The planes S F E and A B E are at right angles. This is, however, only necessarily the case when the plane S F E of the bar is in the meridian. If the bar is lowered so as to open the venetians, the plane F G S E being kept in the meridian, the plane of A B E rotates, but it is always perpendicular to the plane F G E. Suppose that the bar is lowered till the leaf becomes horizontal. Then the lines C E and E D of *fig.* 1 will become parts of one straight line and this line will be the common intersection of the planes of the bar F S G and the leaf A C B.

The ring P E is of material so large in section as exactly to fill the tunnel cut in the lamina D O E. Unless we suppose the length of this tunnel very small, we cannot suppose it to be quite straight and yet exactly filled by a part of the ring. If we give to the lamina D O E a considerable thickness then if the tunnel is quite filled, we

must give to it a certain curvature, *viz.*, the curvature of the ring. Now, in such a case there would be only one *relative* movement possible between the lamina D O E and the lamina B A C E, omitting all consideration of the other leaves and connections. That one possible movement would be as follows:—Take Q the centre of the

Fig. 3.

ring as in *fig.* 3. Through Q draw a line normal to the plane of the ring. About this line make the whole lamina B A C P E rotate, the lamina F S G E being at rest. Thus the ring would begin to move through the tunnel. This is the only movement possible to A C B, if the lamina D E O is fixed. Similarly, if A C B remains at rest the only movement possible to D E O is to rotate about that same line through Q and thus make the tunnel slide along the ring. In this case the plane of the bar leaves the meridian. If the bar does not leave the meridian and if A C B is supposed to have some position given to it, the lamina A C B would have to keep this position. That is, this leaf would be permanently quite closed or permanently open or permanently partly open with FSG in the meridian. Similarly, for the other leaves, so that the venetian arrangement would not act, for the tunnel connection only admits a movement about the line through Q. This movement would displace A or B from its position. The bearings resist this motion. Thus the bearings only allowing a rotation about the line A B and the tunnel only allowing a rotation about a line through Q different in *direction* from A B, the leaf A C B is practically immoveable.

(*To be continued.*)

SEWERAGE SCHEME FOR KARACHI CITY AND ITS SUBURBS.

By J. Strachan, M. Inst. C. E., Municipal Engineer.

(*Continued from page* 342.)

V.

28. The following memo. as to sewers will be useful in preparing the plans and specifications:—

Memo. as to Sewers.

The size, material, and mode of construction of the sewers and their depths and inclinations together with the form, number and arrangement of street gullies, ventilating and flushing arrangements, manholes, lampholes, and other appurtenances, should be according to the following specifications:—

Stoneware Pipe Sewers.

29. Stoneware or earthenware pipes, whether used for street sewers or private house drains, shall be true in form, smooth on the surface, and straight, and of a close-grained, impervious, and thoroughly vitrified material, well burned throughout, and entirely free from air blows, fire cracks, and other imperfections. They shall be well glazed with a salt glaze, both inside and outside, and must be of the minimum thickness specified below:—

4″	pipes not	less than	½″	in thick.
6″	,,	,,	,, ⅝″	,,
9″	,,	,,	,, ¾″	,,
12″	,,	,,	,, 1″	,,
15″	,,	,,	,, 1¼″	,,
18″	,,	,,	,, 1½″	,,
21″	,,	,,	,, 1¾″	,,
24″	,,	,,	,, 2″	,,

30. They shall have full sockets and the latter shall be not less than 2½ inches in depth nor shall the diameter of the sockets be less than from ¾ to 1 inch in excess of the diameter of the pipe. In laying all pipes of this description the joints shall be made as the Engineer may determine, either with puddled clay or with cement in the proportion of 1 of cement to 1 of sand and in such manner that the space all round the spigot, between it and the socket, shall be filled with clay or cement, and the inside of the joint cleaned and freed from any of the superfluous material used. In addition to this, the joints shall be surrounded on the outside with a band of well puddled clay, not less than 8 inches broad, *i.e.*, 4 inches on each side of the socket, and 4 inches thick.

Junction Blocks.

31. Proper oblique junction blocks are to be provided of stone, cement or stoneware as may be determined and as may be suitable for the reception of the junction pipes formed to the proper curvature of the various sewers with which they will be connected.

Lampholes and Ventilating Shafts.

32. All sewers of less size than 2 feet diameter are to be provided with lamphole shafts, carried up to the surface in such a manner that on removing the cover a lamp can be lowered down to the sewer. The cover to be so constructed that it shall also act as a ventilator. The ventilating grate may be either at the side of or in the cover itself, but in this latter case it must be provided with a removable dirt or sludge-box, to prevent street sweepings or sludge passing through the shaft into the sewer. Similar shafts are to be brought up from sewers of the size of 2 feet diameter and upwards, but as they are only for ventilation, the ventilating grate need not necessarily be immediately over the pipe shaft, but may be fixed so as to clear the side of it, as a greater security against deposit of sand through the shaft. These shafts of either description should be placed on sewers, so that their average distance from one another, or from any manhole, shall not exceed 40 yards wherever practicable. The distance between any two lampholes, or a lamphole and manhole, shall in no case exceed 50 yards, except when the introduction of another ventilating shaft would reduce the average distance to below 35 yards. These shafts shall be formed of stoneware pipes, 9 inches in diameter, brought up from the junction blocks in the crown of stone sewer or the junction pipe on pipe sewer. The pipes shall be placed vertically and jointed with cement, and surrounded with six inches of concrete up to the socket of the top pipe. The first pipe must be a special made butt pipe to receive the socket of the next pipe, the remainder being carried up with sockets upwards. The junction pipe for receiving such a shaft in a pipe sewer is to be well bedded in, and surrounded with concrete. The chamber formed round the top of pipe shaft at the surface of the road to be built of stone and the iron cover to be of the pattern which will be provided.

Manholes.

33. Manholes must be provided on all sewers wherever there is a junction of two or more sewers, also at each change of gradient in pipe sewers, and at an intermediate point when the distance between two manholes would exceed 150 yards. They may be circular or square on plan, or of such other shape as circumstances may require, and in all cases where a general plan for a manholes does not meet the case, detailed plans will be submitted for each manhole and lamphole along with the general plan of sewers. Where pipe sewers join a manhole, stoneware, or stone junction blocks shall be built in to receive the ends of the pipes, and the invert of sewers shall be worked round in a curve. Cast step-irons are to be built into all manholes and vertically not more than 14 inches apart. The manholes must be covered with a ventilating cast-iron cover, provided with a sludge or dirt box.

(*To be continued.*)

MOSAIC MARBLE PAVEMENT.

By Lieut-Colonel W. H. Burton, R.E.

This kind of flooring is made with the following tools, materials and labor, in the manner hereinafter described:

Tools.	Materials.	Labor.
2 Iron beaters. 18 small hand hammers.	Stone lime, freshly burnt; Soorkhie powder; Marble powder.	1 European Foreman of works, in constant attendance on the work. 2 Maistries. 6 Bricklayers. 12 Handy boys.
4 Iron straight edges, not less than 6′ × 1½″ × ½″ – 2·2′ × 1½″ × ½″ – 1 c.i. roller 2′ × 15″ dr. with a straight 6′ wood handle. 18 Bars and hold fasts for stone rubbers or smoothing stones.	Spalls, chips and refuse marble of all sorts and colours and Cuddapah slabstone chips and blocks of any shape and size. The above to be of an equal degree of hardness.	4 Bricklayers. 1 Able-bodied man, coolie. 18 Able-bodied men, coolies.
6 Yds. of coarse canvas cloth or gunny bags for rubbing and polishing floor.	Soap	
A full sized plan of pattern of a portion of future floor required to be followed. 2 Wood straight edges about 6′ × 3″ × 2″.	A varnish made of 1 gallon raw linseed oil, ½lb. virgin white wax, ½lb. bar soap, 1 pint turpentine, a little potash; mix in iron or copper pot put over slow fire; stir until it boils. Take off, and when cool it is fit for use. 2½ gallons will polish one square of flooring.	

Having provided the above tools and materials, and arranged for the labor as required by the different processes, and brought the floor to be paved to a solid, unyielding, perfectly stable condition and tolerable level surface by concrete, to a level about 2″ below the level desired for the future Mosaic pavement, when finished, proceed as follows:—

Prepare soorkhie powder in the usual manner and mix it with stone lime in the proportion of 2 parts soorkhie to 1 part of lime unslaked. The lime must be mixed with water to the consistency of ordinary mortar, and kept in that state for 24 hours (in order to ensure thorough slaking) before it is mixed up with the soorkhie. The simplest method of doing this will be found in practice to make a small 6″ or 9″ bund of soorkhie on a clean brick, stone, or wood floor in circular form about 10′ or so in diameter, in order to hold enough lime for one day's (*viz.*, the following day's) use. When mortar has been made it is essential that only so much of the floor, as can be covered with the marble stones according to pattern in one day, should be covered with the chunnam and levelled, &c., on the previous day. If, on the other hand, the chunnam matrix for the marble stones is allowed to remain too long on the floor, before the stones are laid to pattern, the surface becomes too hard and dry for them to be set in it properly.

The mortar should be mixed with water, as required from hour to hour, to the consistency of paste.

The mortar is spread on the floor (the floor being thoroughly wetted and if an old lime floor, even flooded for an hour or two) with a bricklayer's trowel, and made perfectly level (flush with the level desired for the Mosaic pavement) with a wooden straight edge, after which it is to be well beaten with the iron beaters, re-levelled and covered with a thin coat of mortar composed of shell lime 1 part, soorkhie 1 part, and marble powder 1 part. This coat is also levelled and beaten with the iron beaters and then the floor is left until the next day in order to get tolerably firm, sufficiently so in fact that in walking over it the heel of one's boot leaves only a slight impression.

The marble having been broken into little blocks of about ½″ cubes by means of sharp edged hand hammers (*Fig.* II.)—boys 10 to 15 years of age are most easily trained for this work—is brought to the floor in hand baskets, each basket containing marble of only one color and left ready at hand for being set to the patterns of the future floor.

To make the patterns, for all long straight figures, lines, borders, &c., lay the straight edge on the desired line and make the boys, who are to hammer in the stone, fix it in position by keeping their toes on it, they then hammer in the stones of desired colors along the straight edge. For all short straight lines a shorter straight edge might be conveniently used in a similar manner.

To make patterns, other than straight, lay the full sized paper plan on the matrix, and prick pattern through it on to the matrix, after removing the plan outline the figure more indelibly with a small pointing trowel, and hammer in the stones of desired color along the lines marking the pattern.

For the outlines of all figures straight or otherwise the stones are set in the matrix very firmly by the hand hammers, and as closely together as possible. The straight edges being used to form as truly straight lines as possible the stones should be placed on edge, keeping the longest, or straightest side of each stone adjacent to the straight edge and a smooth side, or facet of the stone uppermost.

Bricklayers may also be employed for this work.

When stones forming the outlines or outer edges of all figures, borders, &c., have been thus hammered in over the whole floor, it is time to fill in between the figures, which may be done by spreading over these spaces stones of an uniform color or of two or more colors (probably the Mosaic of this portion of the floor looks best when done with stones of many colors with here and there at irregular intervals, single stones of a deep red, green, &c.) these stones between the hammered-in patterns must be hand spread in order to get them as thick as possible, over the whole surface, up to the point of just avoiding leaving one stone on top of another, as this causes endless future trouble when smoothing down, and possibly a failure of the whole.

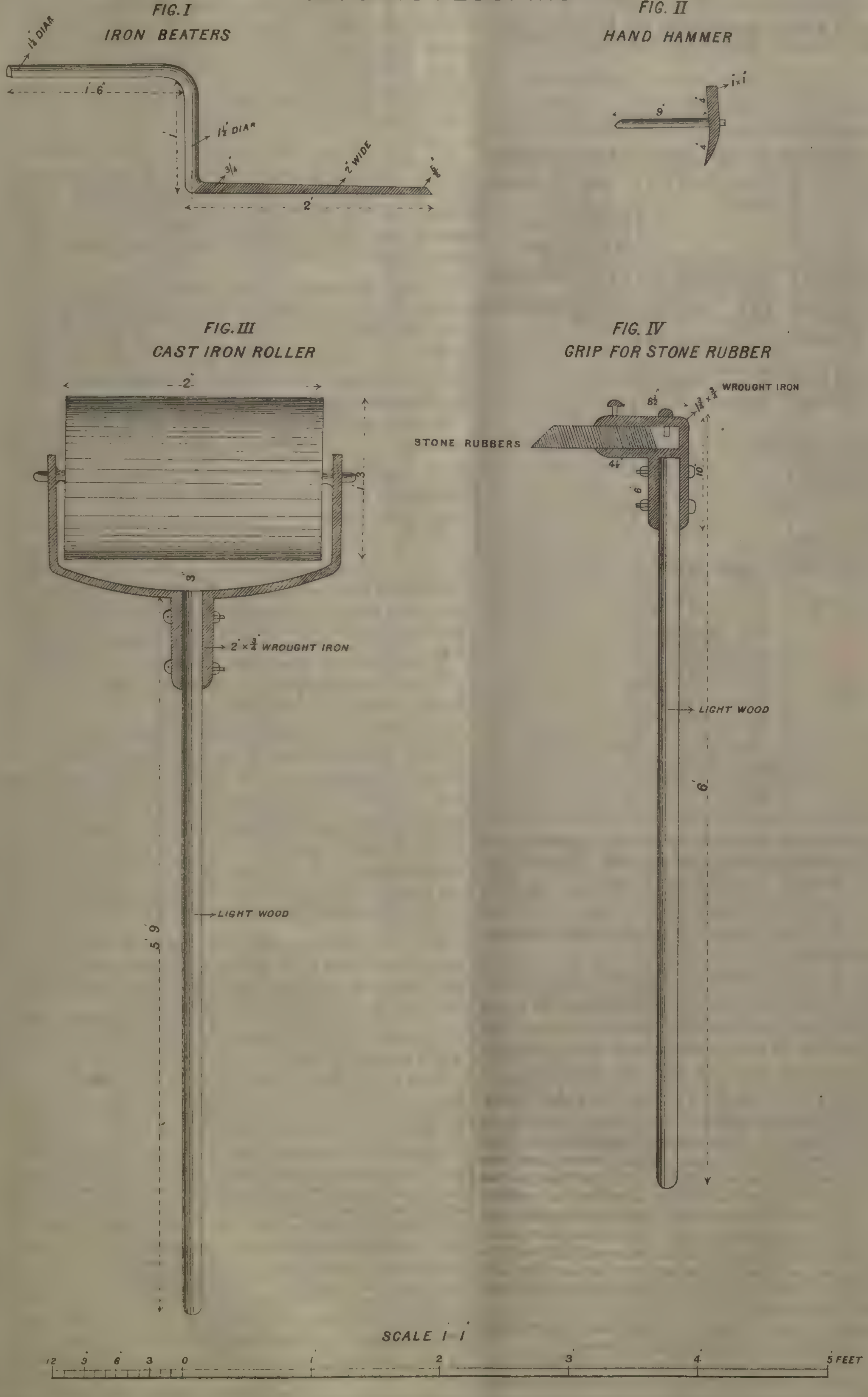
Also, in hand spreading the stones, care should be taken that stones, if of various colors, are mixed, and as they cannot all be of one size, that neither many large nor many small stones are placed together.

Also stones larger than ½″ or ⅝″ cube had best be avoided, otherwise they may work out loose whilst rolling or whilst smoothing down.

After all the marble intended to be used in the pavement has been thus laid to desired pattern (the future general appearance of which may be approximately seen by sprinkling a little water over it) the roller (*Fig.* III.) is applied over the whole, and so the hand-spread stones are thus worked into the matrix, as firmly as the hammered-in stones forming the borders and figures, and the whole marble and matrix is amalgamated and consolidated. Practice alone can tell when the rolling process is best concluded, and the stones hammered in, and consolidated with the iron tool (*Fig.* I.) wherever the roller cannot apply, as in angles of the room and near walls.

All the stones will have now disappeared and been hidden in the matrix, and the floor will soon get tolerably dry again—a 3 days' constant rolling 10 hours a day is none too much for it, as on this depends that necessary firm fixture of each stone, without which the surface cannot possibly be afterwards smoothed and polished.

SKETCHES
OF
TOOLS USED FOR
MOSAIC FLOORING



The free stone rubbers (*Fig.* IV.) are now applied, and firmly dragged forwards and pushed backwards (each one by one able-bodied coolie) until the surface is worn down smooth. These rubbers I should explain are made thus:—take a teak or other hard wood handle, about the size of an ordinary capstan bar, firmly screw a bolt at one end of the iron clamp shewn in the figure (4): in the clamp fasten a right angled triangle of free stone (sandstone) and about 3″ thick, its sides being about 9″ long and its edges straight. This will make an efficient rubber wherewith to smooth down by friction the surface of the floor. After some hours' rubbing, the marble will gradually reappear. If whilst rubbing the floor gets dry and harsh, a very little water may be sprinkled on, to moisten it and render the surface more kind to the rubbing stone.

When a sufficiently smooth surface has been obtained, of which experience alone can judge, the floor should be allowed to dry for 2 or 3 days, when the dust and superfluous mortar still above the marble may be scraped off with wooden hand scrapers and wiped clean with a gunny bag or coarse cloth; after which it must be left till another 15 to 20 days for further desiccation.

When the floor has become thoroughly dry, wash it well with a piece of coarse cloth and soap and water, and dry it with a clean coarse cloth, after which apply the varnish with a clean cloth, taking care that it is uniformly rubbed on all over.

When the floor has been covered with the varnish, it is then polished with clean coarse cloths or old gunny bags fixed in the iron grips (*Fig.* IV.) used for the stone rubbers. The polishing should be continued until the varnish forms into a thin hard skin; when the floor is complete.

The varnish is made as follows:—

Take 1 gallon of raw linseed oil, ½lb. of virgin white wax, ½lb. of bar soap, 1 pint of turpentine, and a little potash; mix the ingredients in an iron or copper pot; put on a slow fire, and keep stirring until it boils; then it should be taken off the fire, and allowed to cool, when it is fit for use.

About 2½ gallons of this mixture will polish 100 square feet.

On the appearance of dust or any other extraneous matter on the floor, it should be washed with a clean coarse cloth, soap and water (bar or carbolic soap is the best) and thoroughly dried with a clean coarse cloth. If a little raw linseed oil is then rubbed over it and wiped off with a clean cloth, it will be of great service, as it keeps the hard skin formed by the varnish from peeling off the mortar joints; when this skin breaks up, the mortar joints have a whitish appearance, and if the oil is not used, when the floor is washed, it must be applied when the mortar joints are observed to be of a whitish color. If this is well attended to, the floor will become much stronger and the polish more durable and brighter year by year. The mortar absorbs the varnish to a certain extent, and it is the frequent washing with soap and water, and rubbing with raw linseed oil, that brings the polish to perfection.

The cost for 1 square of 100 square feet, for this kind of floor, will be as follows:—according to existing rates for labors and materials in Madras.

(1) Preparing and putting down soorkhie mortar including cost of materials	...5-0-0	
Labor for breaking and setting stone	...10-0-0	
14 c. ft. of marble stone including wastage at Rs. 4 per c. ft.	...40-0-0	Ordinary black. white, grey, green, yellow.
(2) Marble stone work	...50-0-0	
(3) Polishing floor including cost of materials	... 5-0-0	
(4) Sundries and wear and tear of tools, &c., at 10 per cent.	... 5-0-0	
(5) Superintendence at 20 per cent.	...15-0-0	

N.B.—All these materials (as also the plant named) except the marble of some colors can be procured in India; for instance, excellent marble can be obtained from the Marble Rocks near Jubbulpore of a yellowish and French grey color, from Kurnool in the Madras Presidency of a green, iron red, reddish grey colour.

Cuddapah slabs (if of lime stone—only some are lime stone) will provide black stones of suitable porosity; white must come from Carara, but can be generally purchased in Calcutta and Bombay, for which the refuse of square marble slab pavements is very suitable; red and white can be procured from Canton, (probably through Commandant Royal Engineers, Hong-Kong,) as also from Malta and Leghorn similarly through Commandant R. E., Malta.

Without black, white, green, grey and yellow in equal parts and about ¼ part of dark red stones, the best description of this pavement will not be possible.

Mr. B. Giovannoni of Allahabad and Agra is, I believe, the only contractor in India who understands this work—even if not the patentee of it. In case any Executive Engineer of the P. W. D. undertakes the work by departmental labor, he should clearly notify beforehand to the many approving, sanctioning and fund authorities that he requires ample time for the work and complete vacation of the house in which it is to be done (if at least more than 1 or 2 small rooms are to be paved.)

Mr. Giovannoni was the contractor who made this floor at Allahabad Railway Station and Hotel. General Fuller, R.E., made it at the P. W. and some other public buildings at Bombay. Mr. Giovannoni also made it at Government House, Madras.

Many other examples of it may be seen at Venice, where it has been common for many hundred years; and at South Kensington, where it has been introduced during the last 3 or 4 years.

THE MADRAS HARBOUR.

Its Construction, Destruction, and Reconstruction.

XIII.

The Madras Committee were reassembled to consider the opinions of the Government of India Engineers, and, with regard to the first opinion expressed by Mr. Molesworth, they remarked that it would be no disadvantage that the sides of the Harbour should be kept low, as the clear water spilling over them would drive the stagnant to sea through the entrance. (2) The Madras Committee were, as formerly, satisfied that the wave-breaker was necessary for the whole of the north side, as it was the more exposed, and recommended to be done as soon as possible: (3) they remarked, with reference to Mr. Molesworth's amended section, that experience had shewn that the rubble base would not stand at 1 to 1; and (4) they felt very strongly, that the northern entrance through the elbow suggested by them was the only satisfactory arrangement, and they supported their opinion by producing those of some of the commanders of the large steamers using the port.

All this discussion seems to have been sent home by the Government of India, and the next document in the Blue Book is an extract from a despatch from the Secretary of State, dated 24th April 1884, forwarding a second report by the Home Committee, on the modifications of their plan proposed by the Madras Committee. The Secretary of State, as might have been expected, had come to the conclusion that the opinion now expressed must be accepted as the final decision on the questions raised. "The entrance to the Harbour will accordingly," he said, "be retained in its original position, and may be narrowed as recommended. The side piers must be raised to the height of 12 feet above high water level, as originally recommended, and if loading places are provided in the manner suggested inside the Harbour, and near the piers, the necessity for raising them still higher will have to be considered. With regard to the method

of re-instating the work, Your Excellency will perceive that the Committee have not pronounced definitely in favor of any one of the three systems mentioned in their original report."

The Home Committee said:—

The change suggested by the Madras Committee requiring the gravest consideration is their proposal to make a new entrance to the Harbour at its north-eastern elbow and to stop up the existing entrance. Their object in making this proposal is to secure stiller water inside the Harbour, a thing desirable in itself if attainable with due regard to other considerations, and they state that the work remodelled in this and in other respects as they recommend will cost much the same as the works advised by us in our report of the 23rd January 1883. The Madras Committee arrive at this conclusion of equality of cost by leaving out from their project the wave-breaker on the south side, and the concrete cap on both sides of the Harbour, * and appear to have assumed, though we are at a loss to know why, that we did not attach any very indispensably constructive value to this portion of our recommendation. They seem to have looked at our proposal to raise the piers by a concrete capping mainly as a question of waves spilling over them into the Harbour, though the observation in our report was that raising the piers to the height we advised would add to the security of vessels within the Harbour in rough weather, and would greatly strengthen the work. We cannot approve of further expensive works, the money for which is chiefly to be found by reducing the strength and efficiency of those recommended in our report of January 1883, which we now see no reason to abate. It follows therefore, in our opinion, that the proposal to form a new entrance and to stop up the old one must be treated as an additional expenditure to that previously contemplated by us. We have consequently estimated the cost of making the new entrance and of stopping up the old one; and taking the overlapping arm, as the Madras Committee shew it, to be 600 feet along, which, in our opinion, would be the minimum length required, we make this additional cost to amount to £127,000. In considering the propriety of incurring such further expenditure, the following observations should be borne in mind. The danger to vessels within the Harbour in a cyclone would arise from the winds as well as from the waves, probably more from the former than the latter, and we think that prudent commanders, on those occasions, would prefer getting out to sea to remaining inside the Harbour. If the piers at the sides of the Harbour were left as low as is contemplated by the Madras Committee, they would in cyclones be nearly, and might be altogether, submerged, and vessels lying in the Harbour would be floating in a receptacle brimful, or nearly so, of water, and exposed on the north and south to the full force of the cyclone. In such case, with submerged piers, vessels breaking from their moorings would in all probability be lost. Though the piers raised to the height we have recommended, while stengthening the work, would afford some additional protection from the wind, we do not assume that even then it would be safe to remain in Harbour during a cyclone.

With regard to the three methods of reconstructing the work, the Home Committee considered that any of them might be adopted with safety, provided they were in no wise weakened by diminution of their dimensions or otherwise. Mr. Parkes, with whom they had had interviews, saw difficulty, as they did, in carrying out the random block system, and would prefer to adopt their cross-sections 1, 2 and 4 (*see* Plate V.) "With regard to this question, we think you may be guided by Mr. Parkes, with the clear understanding, so far as we are concerned, that nothing is done to weaken any of the works recommended by us, whichever of the methods be adopted, and that the piers be not built to a lower level than we have already advised." The Committee gave various reasons for deciding that they could not recommend the construction of the proposed new entrance at the great increase of expense they had shewn would be involved.

The Government of India then called upon the Government of Madras for an expression of their views, but, as in the case of the Despatch from the Secretary of State, of 24th April 1884, part only of their reply has been published. The subject of the suppressed passages may be gathered from the Madras Government's enumeration of the three points specially dealt with in the papers sent to them:—

(1.) The position of the entrance to the Harbour, together with its shape and width.

(2.) The section to be given to the sea-face.

(3.) The officer under whom, as Chief Executive authority, the restoration of the Harbour is to be proceeded with.

With respect to the first point the Madras Government still remained strongly of opinion that the entrance should be placed at the north-east angle of the Harbour, in from 7 to 7½ fathoms of water, and that it should have a width of 300 feet, and they referred to the unanimous opinions of nautical experts formerly submitted in support of this view. If there existed any more competent nautical authority it was earnestly requested that such authority might be consulted before the question was irrevocably settled. They would rather incur the extra expense—£127,000—than keep the present entrance. With regard to the second point the Madras Government said that they greatly preferred the random block-work system. Mr. Molesworth was again consulted, and he complained that the Home Committee had made no allusion to the Notes by Colonel Brownlow and himself, and to the various arguments and suggestions made by him; he saw no reason to modify the views he had expressed in August 1883, and he adhered to all the recommendations he then made, giving in support of them extracts from the opinions of Mr. Scott Russel, the highest authority on wave action, as he was acknowledged to be by French Engineers.

The Master Attendant of Madras next submitted a confidential communication to his Government, on the question of the position of the entrance. "With tears in his words," as the saying is, he implored His Excellency in Council not to acquiesce in the retention of the present entrance, until, at all events, the sense of the community had been sought, and its concurrence obtained. He knew that Mr. Thorowgood thoroughly endorsed his opinion that the eastern entrance ought to be closed, and that if this fearful blunder was not remedied now that an opportunity providentially offered itself, the last chance of a useful Harbour for Madras would be thrown away. But delicacy towards his Chief interfered with the expression of Mr. Thorowgood's opinions. Opinions from seven commanders of large steamers regularly frequenting Madras, in favor of the north-east entrance, are next printed, written in August and September 1883.

In July 1884, the Government of India addressed a last remonstrance to the Secretary of State, forwarding a communication from the Government of Madras, together with a letter from the Madras Chamber of Commerce reiterating objections to certain features in the plan of restoration as settled by the Home Committee, and stating that they concurred generally in the views held by the Madras Government. The Secretaty of State anxiously considered what course he should follow in consequence of this much-to-be-regretted divergence of judgment, but he felt it would be useless again to ask the Committee to reconsider their recommendations, seeing that they were regarded as among the greatest living authorities on works of the description in question, and had already seen and carefully considered all that the Madras authorities and the advisers of the Government of India had to say. He was therefore unable to see any reason for changing the conclusion stated in his Despatch of 24th April 1884, and he forwarded a long report by Mr. Parkes, prepared in communication with Mr. Thorowgood, in which he expressed his concurrence with the conclusions of the Committee. The Secretary of State intimated that Mr. Thorowgood, who was in full possession of Mr. Parkes' views, and of the reasons which had led him and the Committee to adhere to the eastern entrance, had already started on his return to Madras, and the authorities there might confer with him, and it was to be hoped that conflicting views might be reconciled by further discussion. Meanwhile, the plan of operations which Mr. Parkes had proposed would not for several months and possibly for another working season preclude the further consideration of the position of the entrance, as to which, if any additional facts or arguments of sufficient weight should be adduced, a further reference to Engineering authority at home might become desirable. In the meantime, two Titan cranes and a wave-breaker travelling crane had been ordered. Mr. Parkes' estimates should be examined and reported on.

(To be continued.)

* We see we have omitted to mention these two proposed modifications in the proper place above.

A NEW SYSTEM FOR LAYING TELEPHONE AND OTHER TELEGRAPHIC AND ELECTRIC LIGHTING WIRES UNDERGROUND.

(From an occasional Correspondent.)

THIS invention is of much importance seeing that almost all Municipal Corporations have a great objection to the multiplication of overhead wires. There can be no doubt that this objection is perfectly justifiable, as the disadvantages of aërial wires in cities are numerous. They act as a great obstruction and a source of danger in case of fire, their presence in the streets making it a matter of considerable difficulty to get at the houses or to bring life-saving apparatus into use. Further, the multiplications of posts and wires can only be regarded by Municipal authorities as a great disfigurement to a city, while the plan of carrying the wires on posts or brackets attached to the houses is too objectionable to need any comment. The wires are liable to fracture from various causes, and this has frequently led to accidents and injury to life and property in many European cities, notably in London, where such occurrences are by no means uncommon. Another objection is to be found in induction and cross-talking in telephone wires, a well-known source of annoyance, which frequently renders the telephone completely useless.

The scheme which is here described overcomes all these difficulties. It is the invention of Mr. T. R. James, Manager of the Victorian Telegraphs, Melbourne, and the most important part consists of a conduit of highly glazed earthenware laid beneath the footway pavements. The conduit is constructed of pipes, of a special shape, which are fitted together in the same manner as ordinary drain pipes, and which are so made that the upper portion can be removed with the greatest ease to allow of the introduction of as many insulated wires as the section is capable of holding, a pipe six inches in diameter having a capacity for at least sixty wires. At intervals of two feet small outlets are provided at right angles to the pipe and just below the moveable top, through which telephone or electric lighting wires may be led to the houses along the route; so that there need be no more difficulty in connecting them with the central station from which the mains issue, than there would be in laying on gas or water to the same houses. The conduit is also provided with a moveable false bottom, fluted on the underside. The insulated wires rest upon this false bottom and in this way perfect drainage is secured, the water being led by suitable gradients into syphons from which it is drawn off in the ordinary manner. In addition to this a current of air is kept in circulation through the conduit by creating an artificial draught at the central station, fresh air being admitted through ventilating pillars at the terminals in the streets.

The advantages claimed for the system as applied to cities and busy towns are numerous. It dispenses altogether with aërial lines and posts and the arrangements for laying on wires to houses are of the most simple kind. There must be an entire absence of retardation, induction, and cross-talking, as the most perfect insulation exists in the pipes owing to the wires being coated with the best gutta-percha compound to No. 4 gauge, and the conduit itself being an insulator of the best character. The existence of perfect drainage and ventilation also tends to prolong the life of the insulated wires.

It may be stated that in comparison with the cost of erection and maintenance of aërial wires the system patented by Mr. James has the advantage in point of economy, as although the cost of construction is about the same, the expense of securing efficiency when the conduit has been laid will be considerably less than that required for overhead wires.

NOTES FROM HOME.

(From our own Correspondent.)

IT appears that the Railway Regulation Bill is again to be brought forward and that it proposes to invest the Board of Trade with the power to enforce their recommendations with regard to Railway brakes. At a mass meeting of Railway men in Manchester, held on the 17th instant, a resolution approving the Bill and authorizing the Chairman to sign a petition to be sent to Parliament in its favor was unanimously signed. It is suggested that the Government should be asked to appoint a committee of experts, composed of men who have actually worked the different kinds of brake daily, to examine the merits of the several brakes reported as continuous and automatic and report thereon. It is pointed out that a committee so composed would in a couple of hours settle the matter without bias or prejudice, while the inventors would be disputing with each other on the relative merits of their inventions.

The *Engineer* gives an account and description of the Manchester Exhibition buildings, of which Messrs. Maxwell and Tuke, of Manchester, are the architects. Illustrated particulars are also given of the roofs. In these designs care has been taken to use those forms and sections of iron that are commonly found in the market, thus avoiding delay and effecting a very important economy in two respects, for the material was cheaper at first cost, and when its present purpose is served it will be available for the purposes for which it was originally made. The Exhibition was opened by the Prince of Wales on the 3rd instant under favorable auspices.

British India has been our best foreign and colonial customer this year for rails. Our combined exports of iron and steel rails to British India in the first three months of this year amounted to 34,223 tons, as compared with 29,137 tons in the corresponding three months of 1885. The only approach to these figures was made by the United States, to which we sent 31,019 tons of iron and steel rails in the quarter which has just elapsed. The American demand is of an exceptional and precarious character, while our Indian rail exports possess the merit of a certain steadiness and continuity.

It is stated that the Admiralty have determined to make an important departure in connection with tenders for machinery for new vessels. Hitherto the practice has been when a vessel is laid down in a Government establishment to invite tenders for her engines from different firms. It has now been decided to obtain also from the Chief of the Steam Branch of the Dockyard, in which the vessel is to be built, an estimate for the engines, and to consider this estimate in connection with the tenders from the private firms. Should the comparison be favorable to the official estimate, the engines will be constructed in the Dockyard.

The discussion upon the paper on the wells in the London Basin was concluded at the last meeting of the Institution of Civil Engineers, on which occasion several speakers referred to the disputed capabilities of the chalk formation upon which to rely for a London water-supply. The title of the next paper to be read is the conversion of timber by circular and band saws in the Sagismaw Valley, U. S. A., by L. H. Ransome, Stud. Inst. C. E.

Besides the usual reports on recent Railway accidents the *Railway Engineer* for this month gives considerable space to the consideration and analysis of Railway enterprise in India, which forms a continuation of similar articles published in the Journal. This number also contains the official report upon the construction of the Hughli Bridge.

The Mechanical Engineers are to have their next meeting on the 16th and 17th instant, and the following papers will be on that occasion read and discussed. On the construction of Canadian Locomotives by Mr. F. Brown, Experiments on the Distribution of Heat in a Stationary Steam Engine by Major T. English of the War Office, and Mr. J Richards of San Francisco gives a paper on Irrigating Machinery on the Pacific Coast.

The *American Engineering News* gives some interesting notes as to the traffic over the Brooklyn Bridge. Three-car trains have been superseded by four-car trains. At ten miles per hour, and ninety seconds headway, there is only 1,350 feet between the trains. Allowing 45 seconds for unloading—the next approaching train is within little more than 600 feet when the previous one is switched away from the platform. To increase the speed to 15 miles per hour would diminish the headway to 60 seconds and bring one train almost upon another before it could be unloaded.

The official programme of the Spring Meetings of the Iron and Steel Institute, which are to be held in London on the 26th and the two following days in May, have been issued this week. They are likely to be very interesting. The list of papers embrace several different subjects bearing upon metallurgy. Mr. P. Gilchrist, one of the inventors of the basic steel-making process, has a paper on basic slag as a manure, this being an application of basic scoriæ, which has become very general and valuable. Mr. Riley, of the Steel Company of Scotland, promises a paper on Steel Plates. Mr. Turner one on the Production of Silica from Cast Iron. Mr. G. Allen, of the Congreaves Iron Works, near Birmingham, one on the Manufacture of Patent Composite Iron and Steel and Dr. Sosby, of Sheffield, a paper on the Microscopical Structure of Iron and Steel.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Burma, May 28, 1887.

Lower Burma.

Lieutenant W. M. Ellis., R.E., supernumerary Assistant Engineer, 2nd grade, attached to the Rangoon Submarine Defences, has passed the examination prescribed in paragraph 10, Chapter II., of the Public Works Code, Volume I.

Upper Burma.

Mr W. W. Robertson, Honorary Assistant Engineer, Minbu Division, is granted 52 days' privilege leave, with effect from the forenoon of the 13th April 1887.

Burma State Railway.

Mr. H. Groves, Executive Engineer, 2nd grade, reported his arrival in Rangoon on the forenoon of this date.

N.-W. P. and Oudh, June 4, 1887.

Buildings and Roads Branch.

With reference to Railway Branch, North-Western Provinces and Oudh, Office Memo., dated 23rd May 1887, replacing his services at the disposal of the Buildings and Roads Branch of this Government, Mr. C. C. S. Clark, Assistant Engineer, 1st grade, is posted to the Agra Executive Division.

Irrigation Branch.

In Notification dated 17th May 1887, posting Babu Bidhu Bhusan Biswas, Assistant Engineer, 1st grade, on return from furlough, *for* "2nd circle" *read* "1st circle."

India, June 4, 1887.

Major-General Æ. Perkins, C.B., R.E. (Aide-de-Camp to the Queen), Chief Engineer, 1st class, and Secretary to the Government of the Panjab, Public Works Department, having vacated his appointment in the Public Works Department, on promotion to his present military rank, is reappointed to the Department in the same rank and post.

Mr L. G. Prickett, Executive Engineer, 4th grade, temporary rank, State Railways, whose services have been lent to the Indian Midland Railway Company, is granted furlough for six months, with the necessary subsidiary leave, under sections 50 and 64 of the Civil Leave Code, with effect from such date as he may avail himself of it.

The undermentioned officers, employed on the Bengal-Assam Railway, are transferred from the Establishment under the Chief Commissioner of Assam to that under the Chief Commissioner of Burma for employment on Provincial Railways :—

Mr. A. R. Liney, Executive Engineer, 3rd grade.

Mr. E. J. Alexander, Assistant Engineer, 1st grade.

Mr. E. T. Faulkner, Assistant Engineer, 1st grade.

The services of Mr. P. W. Dangerfield, Executive Engineer, 2nd grade, State Railways, are placed at the disposal of the Indian Midland Railway Company, with effect from 3rd June 1887.

The Governor-General in Council is pleased to order the following promotions of Chief and Superintending Engineers, with effect from the dates specified :—

Mr. H. Bell, Superintending Engineer, 1st class, sub. *pro tem.*, to be Superintending Engineer, 1st class, permanent, with effect from 26th November 1886.

Lieutenant-Colonel F. J. Home, R.E., Superintending Engineer, 2nd class, and Chief Engineer, 3rd class, temporary rank, to be Superintending Engineer, 1st class, sub. *pro tem.*, with effect from 26th November 1886.

Mr. R. H. Rhind, Superintending Engineer, 2nd class, sub. *pro tem.*, to be Superintending Engineer, 2nd class, permanent, with effect from 26th November 1886.

Mr. H. F. Storey, Superintending Engineer, 3rd class, to be Superintending Engineer, 2nd class, sub. *pro tem.*, with effect from 26th November 1886.

Mr. T. Higham, Superintending Engineer, 3rd class, sub. *pro tem.*, to be Superintending Engineer, 3rd class, special, with effect from 1st January 1887.

Colonel D. Ward, R.E., Chief Engineer, 2nd class, temporary rank, to be Chief Engineer, 2nd class, permanent rank, with effect from 19th February 1887.

Mr. A. Izat, Superintending Engineer, 2nd class, to be Superintending Engineer, 1st class, permanent rank, with effect from 19th February 1887.

Lieutenant-Colonel C. W. I. Harrison, R.E., Superintending Engineer 2nd class, and Chief Engineer, 3rd class, temporary rank, to be Superintending Engineer, 1st class, sub. *pro tem.*, with effect from 13th February 1887.

Mr. T. H. Wickes, Superintending Engineer, 2nd class, sub. *pro tem.*, to be Superintendent Engineer, 2nd class, permanent rank, with effect from 19th February 1887.

Mr F. B. Walker, Superintending Engineer, 3rd class, sub. *pro tem.*, and 2nd class, temporary rank, to be Superintending Engineer, 3rd class, special, with effect from 19th February 1887.

Major W. Shepherd, R.E., Superintending Engineer, 3rd class, temporary rank, to be Superintending Engineer, 3rd class, sub. *pro tem.*, with effect from 19th February 1887.

Colonel J. G. Forbes, R.E., Chief Engineer, 1st class, temporary rank, to be Chief Engineer, 1st class, permanent rank, with effect from 28th March 1887.

Colonel G. E. L. S., Sanford, C.B., R.E., Chief Engineer, 2nd class, temporary rank, to be Chief Engineer, 2nd class, permanent rank, with effect from 28th March 1887.

Colonel J. G. Lindsay, R.E., Superintending Engineer, 1st class, to be Chief Engineer, 3rd class, special, with effect from 28th March 1887.

Colonel A. LeMessurier, C.I.E., R.E., Superintending Engineer, 1st class, to be Chief Engineer, 3rd class, sub. *pro tem.*, with effect from 28th March 1887.

Colonel J. Browne, C.B., C.S.I., R.E., Superintending Engineer, 1st class, sub. *pro tem.*, to be Superintending Engineer, 1st class, permanent rank, with effect from 28th March 1887.

Colonel B. Lovett, C.S.I., R.E., Superintending Engineer, 2nd class, temporary rank, to be Superintending Engineer, 2nd class, permanent rank, with effect from 28th March 1887.

Mr. J. W. Buyers, Superintending Engineer, 3rd class, sub. *pro tem.*, to be Superintending Engineer, 3rd class, special, with effect from 28th March 1887.

Mr. J. Ramsay, Superintending Engineer, 3rd class, temporary rank, to be Superintending Engineer, 3rd class, sub. *pro tem.*, with effect from 28th March 1887.

The Governor-General in Council is pleased to order the following temporary promotions and reversions to and in the classes of Chief and Superintending Engineers, with effect from the dates specified :—

Mr. G. A. D. Anley, Superintending Engineer, 1st class, to be Superintending Engineer, 2nd class, with effect from 7th January 1887.

Major W. G. Nicholson, R.E., Superintending Engineer, 2nd class, to be Superintending Engineer, 3rd class, with effect from 7th January 1887.

Colonel J. G. Forbes, R.E., Chief Engineer, 2nd class, to be Chief Engineer, 1st class, with effect from 27th February 1887.

Colonel G. E. L. S. Sanford, C.B., R.E., Chief Engineer, 3rd class, to be Chief Engineer, 2nd class, with effect from 27th February 1887.

Mr. F. L. O'Callaghan, Superintending Engineer, 1st class, to be Chief Engineer, 3rd class, with effect from 27th February 1887.

Mr. G. A. D. Anley, Superintending Engineer, 2nd class, to be Superintending Engineer, 1st class, with effect from 27th February 1887

Colonel B. Lovett, C.S.I., R.E., Superintending Engineer, 3rd class, to be Superintending Engineer, 2nd class, with effect from 27th February 1887.

Mr. J. Ramsay, Executive Engineer, 1st grade, to be Superintending Engineer, 3rd class, with effect from 27th February 1887.

Mr. J. R. Bell, Executive Engineer, 1st grade, to be Superintending Engineer, 3rd class, with effect from 6th March 1887.

Colonel C. H. Luard, R.E., Chief Engineer, 2nd class, to be Chief Engineer, 1st class, with effect from 9th March 1887.

Mr. R. T Mallet, Chief Engineer, 3rd class, to be Chief Engineer, 2nd class, with effect from 9th March 1887.

Lieutenant-Colonel T. C. Manderson, R.E., Superintending Engineer, 2nd class, to be Superintending Engineer, 1st class, with effect from 9th March 1887.

Lieutenant-Colonel G. T. Skipwith, R.E., Superintending Engineer, 3rd class, temporary rank, to be Superintending Engineer, 2nd class, with effect from 9th March 1887.

Colonel C. M. Browne, R.E., Chief Engineer, 2nd class, to be Chief Engineer, 1st class, with effect from 14th March 1887.

Colonel C. J. Smith, R.E., Chief Engineer, 3rd class, to be Chief Engineer, 2nd class, with effect from 14th March 1887.

Colonel J. P. Steel, R.E., Superintending Engineer, 1st class, to be Chief Engineer, 3rd class, with effect from 14th March 1887.

Mr. J. W. Wright, Superintending Engineer, 2nd class, to be Superintending Engineer, 1st class, with effect from 14th March 1887.

Colonel D. Ward, R.E., Chief Engineer, 2nd class, to be Chief Engineer, 1st class, with effect from 7th April 1887.

Mr. F. L. O'Callaghan, Chief Engineer, 3rd class, temporary rank, to be Chief Engineer, 2nd class, with effect from 7th April 1887.

Mr. F. J. Johnstone, Superintending Engineer, 1st class, temporary rank, to be Chief Engineer, 3rd class, with effect from 7th April 1887.

Mr. R. H. Rhind, Superintending Engineer, 2nd class, to be Superintending Engineer, 1st class, with effect from 7th April 1887.

Lieutenant-Colonel W. G. Cumming, R.E., Superintending Engineer, 3rd class, to be Superintending Engineer, 2nd class, with effect from 11th April 1887.

Mr. T. H. Wickes, Superintending Engineer, 2nd class, to be Superintending Engineer, 1st class, with effect from 28th April 1887.

Major W. G. Nicholson, R.E., Superintending Engineer, 3rd class, to be Superintending Engineer, 2nd class, with effect from 28th April 1887.

Colonel G. E. L. S. Sanford, C.B., R.E., Chief Engineer, 2nd class, to be Chief Engineer, 1st class, with effect from 17th May 1887.

Colonel J. P. Steel, R.E., Chief Engineer, 3rd class, temporary rank, to be Chief Engineer, 2nd class, with effect from 17th May 1887.

Mr. H. Bell, Superintending Engineer, 1st class, to be Chief Engineer, 3rd class, with effect from 17th May 1887.

Colonel B. Lovett, C.S.I., R.E., Superintending Engineer, 2nd class, to be Superintending Engineer, 1st class, with effect from 17th May 1887.

Mr. T. Higham, Superintending Engineer, 3rd class, to be Superintending Engineer, 2nd class, with effect from 17th May 1887.

Mr. G. W. MacGeorge, Executive Engineer, 1st grade, to be Superintending Engineer, 3rd class, with effect from 17th May 1887.

Lieutenant-Colonel J. H. Crowdy, R.E., Superintending Engineer, 3rd class, sub. *pro tem.*, to be Superintending Engineer, 2nd class, with effect from 3rd June 1887.

Major W. H. Coaker, R.E., Executive Engineer, 1st grade, to be Superintending Engineer, 3rd class, with effect from 3rd June 1887.

Director-General of Railways.

Babu Baroda Pershad Bosu, Executive Engineer, 4th grade, sub. *pro tem.*, is posted to the Bellary-Kistna State Railway, and the Notifications dated 29th June 1886, 13th April 1887, 9th May 1887 by the Director-General of Railways relating to that officer are hereby cancelled.

North-Western Railway.

Lieutenant O. M. R. Thackwell, R.E., Assistant Engineer, 1st grade, attached to the North-Western Railway, is granted six months' special leave to England on urgent private affairs, with effect from the 16th May 1887, or such subsequent date as he may avail himself of it.

Punjab, June 2, 1887.

Irrigation Branch.

Mr. R. W. Rowland, Assistant Engineer, 1st grade, attached to the 5th Division, Sirhind Canal, is allowed Examination leave for three months, from the 28th May 1887, or such subsequent date as he may avail himself of the same.

Mr. T. J. P. Jeffery, Executive Engineer, 2nd grade, Upper Sutlej Division, Inundation Canals, is allowed furlough to Europe for fifteen months, from the 28th June 1887, or such subsequent date as he may avail himself of the same.

Mr. A. J. Soratchley, Executive Engineer, 4th grade, temporary rank, from the 1st Division, Bari Doab Canal, which he left on the forenoon of the 29th April 1887, to the Chenab Canal Division, which he joined on the afternoon of the 30th idem. The transfer was made in the interests of the public service.

Bengal, May 8, 1887.

Establishment—General.

Rai Krishna Chundra Bandopadhya Sahib, Assistant Engineer, 1st grade, is appointed to hold charge of the Patna Division, *vice* Mr. J. A. Price, whose services have been placed at the disposal of the Government of India.

Kali Prosonno Mukerji Sahib, Executive Engineer, 4th grade, temporary rank, is appointed to hold charge of the Rajshahye Division, *vice* Rai Madhub Chunder Roy Bahadur, who has been appointed Inspecter of Local Works in the Burdwan Division.

The services of the officers named below are placed at the disposal of the Government of India :—

Mr. J. T. Simpson, Executive Engineer, 2nd grade.
„ J. A. Price, ditto ditto, 3rd do.
„ W. P. Milne, ditto ditto, 4th do., sub *pro tem.*

This cancels the notification, dated 6th May 1887, transferring Mr. Milne to the Rajshahye Division.

Central Provinces, June 4, 1887.

With reference to notification dated the 26th current, Mr. C. S. R. Palmer, Assistant Engineer, joined the Nagpur Division on the forenoon of the 18th idem.

With reference to notification dated 29th April 1887, Mr. C. O. Leefe, Executive Engineer, joined the Nagpur Division on the 18th current.

Mr. G. G. White, Executive Engineer, 4th grade, reported his arrival at Pachmarhi, on the forenoon of the 27th May 1887, from the three months' privilege leave granted him on the 1st March 1887, and is appointed to the charge of Khanhan Division.

Mr. M. Leslie, Executive Engineer, 3rd grade, in charge of the Kanhan Division, on being relieved by Mr. G. G. White, Executive Engineer, is appointed as Assistant Secretary to the Chief Commissioner, Central Provinces, Public Works Department.

Mr. W. G. Newton, Executive Engineer, 3rd grade, and Assistant Secretary to the Chief Commissioner, Public Works Department, Central Provinces, on being relieved by Mr. M. Leslie Executive Engineer, is appointed to the charge of the Eastern Division.

Mr. J. B. Leventhorpe, Executive Engineer, 4th grade, temporary, on being relieved by Mr. W. G. Newton, Executive Engineer, will remain attached to the Eastern Division until further orders.

Assam, June 4, 1887.

Privilege leave for three months, is granted to Mr. E. J. Mitchell, Assistant Engineer, Second Grade, with effect from 18th June 1887, or such subsequent date as he may be permitted to to avail himself of the same.

Notices.

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CONTENTS.

Obituary.

Holroyd—At Dalhousie, on the 30th May, John Thomas Holrayd, Carding Master, Egerton Woollen Mills, aged 27 years, late of Saddleworth, York.

Balcher.—At Auerley, London, S.E., England, on the 21st April, P. F. Balcher, c.e., Contractor, aged 52 years.

INDIAN ENGINEERING.

SATURDAY, JUNE 18, 1887.

MINERAL RESOURCES OF CHOTA NAGPUR.

Thoughtless people who launch into discussions on the poverty of India, are little aware of the material resources in which the country abounds even to this day. It is true the hoarded coffers of the indigenous princes, and of their Mahomedan conquerors, have been swept away by the advancing tide of events: the Peacock Throne of Delhi, the wealth of the Lion of the North, with his Koh-i-nur, Durrea-i-nur, &c., which excited the cupidity of warrior kings are no longer in existence. Their disappearance, however, has not impoverished the country. What was visible to the eye and could be acquired at the point of the sword, naturally inflamed the imagination and exaggerated the value. But the real treasures of India are hid away from the sight, beneath the surface. They are an inexhaustible source of prosperity of which the people were not aware, or if they had been, they certainly lacked the necessary technical knowledge and appliances to bring it to light. Thanks to British enterprise and British capital, a good deal has been done towards developing it.

Whichever way we turn we find that discoveries are being constantly made of the mineral resources of the land. Practical men have established themselves in all the Provinces, laboring hard at the problem how to make the earth give up its products. We are not therefore surprised to learn form an interesting paper in the *Asiatic Quarterly Review* that Chota Nagpur is rich in mines. In giving an account of the country the writer seems to have taken a leaf out of the "Arabian Nights," and the reader finds himself translated into Fairy Land. "Besides gold," says Mr. Hewitt, "diamonds used to be found in the Sunk river .... near the region of the Palamow coal fields; and Tavernier, the French traveller, who visited India in the beginning of the 17th century, describes his visit to the mines. The Raja of Chutia Nagpur has among his family jewels a very valuable diamond taken from these mines." Then there are large deposits of copper and lead ores, tin and manganese, and it only requires funds to work them to advantage.

We are not at present concerned with these, our object is to invite public attention to the existence of extensive coal fields and valuable stores of iron ore distributed throughout the province. The Barrakar works are referred to as yielding considerable profits, and there is another site still unoccupied in the vicinity of Balvornath to the north-west of Lohardugga close to the proposed Benares-Katack Railway. A bright future is predicted of these fields, and Mr. Hewitt feels justified in claiming for them the position of the future Sheffield of India, and certainly this is not an exaggerated estimate. There are 21 coal-fields distributed all over the division covering an area of 6,751 square miles; besides this there is one at Tilchur in Orissa having an area of 700 square miles. There are others

of which scarcely anything is known except from the opinions formed on their merits by geological experts. The writer succinctly explains the value of each of these fields to the country which lies contiguous to it. The northern fields will bring benefit to the people of the North-West and Behar, not only in supplying them with a fuel cheaper than wood and charcoal, but also for manufacturing purposes, thus giving employment to the inhabitants of over-populated districts. The Umaria fields, of which such glorious results are anticipated, will provide coal for Allahabad and the country to its west, while the Daltonganj and Hutar fields will supply the demands of Benares and the whole of the eastern tract including Oudh. The line from Benares to the Daltonganj fields will form the first section of the proposed Benares-Katak line, a branch line being laid between the latter and Gya, a distance of about 80 miles: this will complete the communication with Behar.

But the question of questions is, admitting everything the writer has urged in support of his position, will the returns justify the cost of the undertaking. He says, speaking from analogy, and the experience gained in the Kurhurbaree works, the cost of coal conveyed to Benares, including all charges, will be Rs. 6 per ton, and to Gya will be Rs. 5. The price of wood at the latter place is Rs. 9 per ton, so that even if the coal is converted into coke, it would yet be cheaper than the ordinary and expensive fuel of the country. Now, the cost of the Railway estimated by Government Surveyors will not exceed £12,600 per mile, and calculating the distance from Benares *viâ* Daltonganj to Gya at 230 miles at the outside, it will not be more than £2,900,000 for the entire way,—a very moderate sum, considering that the line will supply coal to over 300 millions of people, and to the Oudh and Rohilkand, and Bengal and North-West lines.

With regard to the argument of the opponents of the scheme, that the Indian ryot is too conservative to accept a cheaper substitute for the antiquated wood and charcoal, Mr. Hewitt might have spared himself the unnecessary trouble of demolishing the fallacy. We know from past experience how the barriers of conservatism have crumbled into dust, not only before the advancing tide of Western ideas, but before self-interest, which has become a potent factor in the everyday life of even the intelligent classes, leaving aside those who live from hand to mouth. As for religious scruple there is none, and if there were, it would disappear too. When "water-works" were first talked of for towns, objections were raised to the higher castes using the water. But we see a different state of things now; Christians, Mahomedans, Brahmins, Khetries, Sudras, &c., all crowd around the hydrant helping themselves to that necessary of life. Of course, native hearths are not suited to the burning of coke and coal, but the same change that has come over Bengal in this direction, will be instituted at no distant date in other parts of the country. The adoption of coke will have another salutary effect; instead of using dried manure as fuel, it would be returned to the fields and check the deterioration of the soil. Independently of all other advantages, there is the necessity of providing against famines which periodically visit India. The arguments on this head are so cogent that we will allow Mr. Hewitt to speak for himself: he says: "It will, when completed and its results are worked out, ensure to the people a supply of food adequate to their wants under all circumstances; it would stop the degeneration of the soil that must increase yearly as long as crops are raised without restoring to the ground the chemical elements that were taken from it, and will supplement the work done by the canals. If it has been thought advisable to spend millions on making them, so much the more necessary is it to ensure that their expenditure shall all be to the good, and that the canals shall not, as they do now, take away with one hand what they give with the other, depleting the soil by taking from it, not only increased crops, but the fertilizing elements which combine with the canal water to produce them."

THE MADRAS COLLEGE OF ENGINEERING.

In 1859 the Survey School, which had for a long period been in operation at Fort St. George, was transformed into a Civil Engineering School with the object of supplying trained subordinates for the Public Works Department. In 1862 a collegiate branch was added, which was open to civilians studying for the University degree in Engineering, as well as to military officers desirous of qualifying for employment on Public Works. Such is the brief history of the Madras College of Engineering as given by Colonel Shaw Stewart, R.E., on the occasion of the Prize Distribution last year. It was then observed that the institution was about to enter on a new phase of existence, and that change is thus epitomised by Mr. J. H. Garstin, C.S., C.S.I., who presided at the same ceremony this year:—The object of the new scheme of studies is, by raising the standard of education, to turn out a supply of more highly finished, and therefore more competent officers for the Public Works Department. The new class of Civil Engineers will have to go through three years' study in the College, followed by two years of practical instruction—one on large works in progress under the Public Works Department, and the other in the workshops of that Department. So too, the Mechanical Engineers, except that in their case the two years of practical study will be passed entirely in large public or private workshops. It seems clear, therefore, that at the end of the period of 5 years every one of these students who makes the most of his opportunities is pretty sure to be a fairly good practical Civil or Mechanical Engineer.

The report of the College for 1886-87 is considered of more than usual interest, inasmuch as it is the first since the introduction of the new scheme of studies into the College. We glean from it that of the 166 students on the rolls, no less than 127 are Hindus, of whom 79 are Brahmins. The other classes of the community were, Europeans and Eurasians 24, Native Christians 12, Mussulmans 2, others 1. There was a slight falling off in the total as compared with the previous year, and this is ascribed to the enhanced fees, to the increased lengths of the courses, and, perhaps, to the difficulty

in obtaining employment on leaving the College. There are two prominent facts in the academic history of the institution, *viz.*, (1) the appointment of a native graduate (an alumni of the College) to the post of special Mathematical Master for the Officers' Surveying Class, a Department recently added to the College for Probationers in the Survey Department; and (2) the carrying off of the Royal Engineer Officers' Prize, awarded to the most distinguished student of the Second Department, by a Mahomedan.

There can be no question that the institution is making steady progress, not only in the quality of its outturn, but popularity. It has been well observed that "the ranks of the Public Works Department are almost exclusively filled with its alumni; the Superior establishment of the same service is beginning to admit a select few; while the balance of its passed students have little difficulty in obtaining employment under Local Boards, and Municipalities," or in numerous other situations where their services are indispensable. In Mr. Garstin's opinion, it seems, that the prospects of the College students under the new scheme are considerably improved. He believes that the education given in it offers to domiciled Europeans and Eurasians especially, as well as to Natives, the means of adopting one of the most interesting professions which a man can choose, and he adds that "with the increasing civilization of the present day, the wants of the human race have become greater. The luxuries of the past have become the necessities of the present, and in administering to them, no one has a greater share than the Engineer. In all branches of constructive art his skill and energy are ever increasingly exercised, whether in building ships or houses, or constructing engines, railways, weirs, locks, bridges or canals, and the greater the work the greater the fame and glory of carrying it out to a successful conclusion."

COLOMBO WATER WORKS.

THE result of the commission of enquiry into the cause of failure of the Maligahakanda reservoir is still unknown, and Mr. Bateman, although asked, declines to express any opinion until officially interrogated, expressing at the same time entire confidence in the judgment and professional skill of the Resident Engineer. In the meantime, any suggestion for repair seems in abeyance, the water being supplied direct from Nyawakanda, but complaints are loud as to its quality, some going so far as to say that it is bad and unusable. Whether this report is true or not, or brought about through local causes, it is very unfortunate, as it is apt to prejudice the native population for some time. Still more unsatisfactory is the financial position of the Colombo Water-Works. When the final bill can be made out, or who is finally to pay it is impossible to say: but in the meantime as regards the debentures now in force and the liabilities they impose, there is a very pretty quarrel going on between the Government and the Municipality. The former insist on the latter providing Rs. 1,10,000 a year of the total amount for interest and charges—a proportion fixed at a time when not only were the Municipal revenues in a very much more flourishing condition than at present, but also when an estimate of income from sale of water was made at a much higher figure than can possibly be imposed now. Government require the carrying out of the full letter of the bargain by the Municipality, but the latter, pleading poverty, ask, in view of the altered state of affairs, to be allowed to add to their resources a rack rent and some minor levies. To this Government decline to accede, pointing to economy and retrenchment in existing expenditure as the proper means for the raising of the money. Hence the Municipality propose to appeal to the Secretary of State. A new Municipal ordinance is now only waiting Her Majesty's sanction, so that next year a new *régime* will (may be) be in full force, and hence, Government should not further provoke a discontented and troublesome set of native councillors.

ASBESTOS PAPER.

ASBESTOS has been used for various purposes, but an enterprising individual of the name of Ladewig has discovered a process for manufacturing from Asbestos fibre a pulp and a paper which he declares resist the action of fire and water, and absorb no moisture whatsoever. The pulp, he says, has been used successfully as a stuffing, and for the joints of Engines. The process of manufacture consists in mixing about 25 per cent. of Asbestos fibre with about from 25 to 35 per cent. of powdered sulphate of alumina. This mixture is moistened with an aqueous solution of chloride of zinc, after which it is washed with water, and then treated with an aqueous solution of amoniacal gas. It is again washed, and then treated with a solution composed of one part of resin soap and 8 or 10 parts of water, mixed with an equal bulk of pure sulphate of alumina. The result should be of slightly pulpy consistency. To this is finally added 35 per cent. of powdered Asbestos, and five to eight per cent. of white barytes. This pulp is then treated with water in an ordinary paper machine, and worked just like paper pulp. To manufacture solid cardboard proof against fire and water, and capable of serving as a light roofing material, sheets of common cardboard, tarred or otherwise prepared, are covered with the pulp. The application is made in a paper machine, the pulp being allowed to flow over the cardboard. Among other uses, this Asbestos paper is recommended for the manufacture of cigarettes; but if it is fireproof, it is not quite clear how it could very well be utilized for cigarettes.

A STRONG syndicate has been formed of Belgian and English capitalists for the construction of 1,500 miles of railways in China. The proposal, which has been made to the Chinese Government through the Belgian Minster at Peking, is to place a sum of 32 millions sterling in the hands of the Government to be repaid in ten annual instalments. The lines proposed to be built are one from Nanking across the Yangtsze and along the Grand Canal to Peking, 800 miles in length, and the other from Canton to Hanoi, 700 miles in length.

Notes and Comments.

NERBUDDA COAL AND IRON COMPANY, LIMITED.—The accounts of this Company for the year 1886 shew a loss on working of £605. After deducting this amount, and debenture interest, &c., the balance to credit of Profit and Loss of £1,946 brought forward, is reduced to £798.

LIGHTING PALACES IN INDIA.—The Gülcher Company have, we hear, received orders for three installations for lighting palaces in India; the present order consists of one 100-light installation, two 50-light installations, with engines, boilers, dynamos, accumulators and fittings complete.

THE PATENTS BILL.—The Patents Bill, which is now before the Imperial Council, will not be proceeded with in its final stages until the Government returns to Calcutta. The Legislative Department is now collecting and considering opinions which have been expressed on the Bill by persons interested.

TROPICAL SANITATION.—The policy of the Hong-Kong Government with respect to overcrowding in the city of Victoria was unfolded at a recent meeting of the Legislative Council of the Colony in connection with the introduction of the Public Health Bill. It is proposed to make it compulsory to allow in every house 300 cubic feet of space to every adult occupant.

THE KHOJAK PASS RAILWAY.—The survey for a railway over the Khojak Pass will be complete as far as Chaman in a few days. A tunnel, three miles long, is to run through the hill, which will take two-and-a-half years to complete. If necessity requires that the line should be constructed at short notice, a loop line will be run up to Khojak and down to Chaman and worked by stationary engines at the Pass.

FURTHER COAL PROSPECTS IN THE CENTRAL PROVINCES.—We are informed that borings are in progress at Karba, C. P., but the results so far have not been very satisfactory. The only additional positive knowledge we possess relative to the mineral resources—as regards coal and iron—of the Central Provinces and Chota Nagpur, over and above that furnished by Ball in the "Economic Geology of India," is that afforded in the "Records of the Geological Survey," Vol. XIX.—part 4.

COAL MINING COMPANIES IN BENGAL.—The report of the Raniganj Coal Association, Limited, for the year ended 31st March 1887 is a marked improvement on its predecessor, and discloses a profit on the working of Rs. 51,274, and the Managing Agents propose to set aside Rs 10,000 for depreciation, to pay a dividend of 5 per cent. and to carry forward Rs. 3,090. The report of the Bengal Coal Company for the half-year ended 30th April discloses a net profit of Rs. 2,21,169, and the Directors have transferred Rs. 30,000 to wear and tear, and recommend that a dividend of 7 per cent. be paid, and Rs 1,24,384 be carried forward. The dividend for the past year has thus been 12 per cent., against 11½ for the one preceding.

THE GAIETY THEATRE, SIMLA.—The new Theatre in the Town Hall of Simla is described as of quite the bijou type. The stalls are roomy and comfortable; the drapery of the boxes is very prettily and artistically arranged, the ventilation is as near perfection as can be gained, while the stage, lighted in a way that a London manager might envy, though gas is not used, is in itself, as it should be, the best feature of all. Mr. Irwin's design is undoubtedly a great credit to him, and it has been admirably worked out by Mr. Andrew Cameron, the Engineer-in-charge, who has received advice and assistance in many details from the architect and Mr. Hebbert, lately Executive Engineer of the Imperial Circle. The iron roof and all the other iron work is from Messrs. Richardson and Cruddas of Bombay.

THE VOLUNTEERS HEAD-QUARTERS BUILDING, CALCUTTA.—The question of the site for the Volunteers Head-Quarters, Calcutta, has at length been settled. The building will be erected between the new Swimming Bath and the Eden Gardens. The only difficulty still remaining is to reconcile the views of the Commander-in-Chief and the Bengal Government. The former insists that only a temporary building capable of being quickly demolished should be erected, while the Government wish to have a permanent structure. While this knotty point is being fought out the Volunteers are practically homeless, as their present Head-Quarters are most unsuitable. When one considers the importance of every fighting man at the present juncture of affairs, one cannot help thinking that this is not as it should be.

SOMETHING WRONG SOMEWHERE?—Bad times seem to be impending over the Public Works Department. The making over of State railways to three new companies has already resulted in throwing some 150 Engineers on the hands of Government, for whom there is absolutely nothing to do, and already compulsory furloughs and retirements are being spoken of. At the same time wholesale promotions have been made to Chief and Superintending Engineers, though what they are to "Chief" or "Superintend" is so far a mystery, as there are, we are told, a Superintending Engineer and a Chief Engineer, both of high standing, in charge of simple surveys! Then, again, the new companies are recruiting men at home without Indian or even professional experience, while we have 150 good men standing idle out here. If this is not bad administration, what is it?

THE UNEQUAL OPERATION OF CANTONMENT RULES.—A Bombay paper says, that there is no obvious reason why the Military Secretary to Government and the Public Works Secretary, because he happens to be an Engineer officer, should have the advantage of cantonment rules any more than the Revenue Secretary to Government or the Political Secretary to Government. A short time ago a Civilian residing in regimental lines was ordered to vacate his house for an Executive Engineer who happened to be a military man. The Executive Engineer's superior, who also happened to be a military man, had allotted to him by Government one of the few official houses in civil lines. Military men belonging to the Public Works Department ought to be treated as Civilians. In fact, technically, the Public Works Department is not recognised as a military department by the Supreme Government.

THE FEROZEPUR BRIDGE.—The Governor-General in Council records his great gratification at the able and expeditious manner in which the bridge over the Sutlej at Ferozepur has been brought to a conclusion. His Excellency has much pleasure in recording his special thanks to Mr. R. Mallet for the talent displayed by him in the preparation of the design for the bridge and for his labours in the preliminary construction operations. Also to Mr.

J. Bell, under whose able and energetic supervision, already exhibited on more than one occasion, the erection of the bridge has been brought to a successful completion. His Excellency also desires cordially to acknowledge the services of the other officers who have been employed on the bridge works, as also the labors of the subordinate staff. Thanks have seldom been better deserved, whether regard is had to the excellence of the work itself or the time in which it was completed.

MANDALAY "GUP."—A Correspondent writes:—It is rumoured here that the Chief Commissioner is coming to Mandalay about the third week of June, and that he is bringing up his Chief Secretary, Mr. Donald Smeaton, with him. This as a matter of course. But what is curious is, that he is said to be bringing up also Colonel W. G. Cunning, R.E., Secretary in the D. P. W., *Lower* Burma. Sir Theo Cracraft's last venture of fitting a square man into a round hole is not turning out a success. Major Gracey, R.E., the newly appointed Secretary in the D. P. W., *Upper* Burma, is, it is whispered, meddling and muddling, even though he is a heaven-born, and so his Lower Burma *confrère* is being brought up to put D. P. W. matters ship shape. To the uninitiated public this appears a senseless move, as a better man than either Colonel Cumming or Major Gracey is on the spot,—I allude to that officer of ripe Burman experience, Mr. H. J. Richard, C.E.

BETTER LATE THAN NEVER!—There seems to be some prospect of a railway being constructed on the West Coast of Sumatra, to tap extensive coalfields in the valley of the Ombilien river. A Bill has been brought into the Netherlands States General authorising its construction by Government. In Sumatra, so far, the only railway in operation is a private line in Deli. The Ombilien fields have long been famed for the quantity and good quality of the coals found there. For years, private enterprise has vainly sought to move the Government to take some action for the development of that productive region. The Netherlands Indian Government will, it is said, also make provision for stretching a telegraph line across Sumatra from West to East to continue the existing lines to Deli. There is some talk too of laying a cable from Situbondo in Java to Macassar in Celebes *viâ* Bali Buleling. Borneo and other principal islands in the Netherlands Indian Colonies are so far still cut off from telegraphic communication.

THE UPPER BURMA RUBY MINES.—The Regulation just passed by the Government of India relating to rubies and other precious stones in Upper Burma applies to the whole of our new province except the Shan States. Under its provisions the Local Government has power to grant ordinary licenses for mining to native residents in the stone tracts working by native methods, and extraordinary licenses to mine by any method. No one is to cut or dress stones within the limits of a stone tract, or without a license beyond such limits. Ordinary licenses will be granted to headmen on existing claims after a list has been made out of all native residents in the stone tracts. Stones raised under ordinary licenses will have to be sold at the owner's valuation to the lessees holding an extraordinary license, or such percentage of value will be paid as the Local Government decide. A ruby mart is to be re-establised at Mandalay, and all precious stones are to be carefully registered. Special provisions are made to prevent smuggling or illicit sales, power of search being given to Government officials.

COLOMBO BREAKWATER.—Our Correspondent writes:—I noticed your paragraph which states that the Colombo Harbour had been materially ruptured and injured by the violence of the south-west monsoon. I cannot find any subsidence beyond that to be expected during the course of settlement common to all marine works of the kind founded on *pierre perdue*, and the cracks observed occur in the concrete capping of the breakwater and not in the body of the work. Such cracks were anticipated, and wood slips were inserted in the concrete to give it some regularity. As to "the upper blocks in one portion having been torn away to get at defective and honey-combed work below," I fear this must have been founded on the discovery of a single block having a flaw, and that block being removed and replaced by a sound one. Repeated levels taken indicate scarcely any appreciable settlement throughout the whole work, and none has occurred from the violence of the south-west monsoon. The whole work is as perfect and safe as could be desired.

INDIAN MIDLAND RAILWAY.—The bridge over the Jumna at Kalpi has been now completed. This bridge is a very handsome structure, consisting of 10 spans of 250 feet on steel, erected on piers 60 feet from the waterway. Each girder weighs 317 tons. They have been erected by Mr. Bayly, a well-known contractor on the Bombay side and celebrated for his works on the Nerbudda Bridge. He commenced work in October 1886. To an amateur's eye the structure appears too light, and it is difficult to see why a separate roadway could not have been made in connection with it. When the approaches are made, carts will have to cross on the rails, which is obviously objectionable. Thirty miles of rail are already laid from Bhopal and four from Manickpur, while Messrs. Glover & Co. are making rapid progress on the Jhansi-Gwalior section, all the earthwork being practically completed. Next November Mr. Bayly will commence erecting the girders (thirteen of 150 feet) over the Betwa river on the Jhansi-Manickpur section, and over the same river (nine of 150 feet) on the Jhansi-Bhopal section.

THE NEW MARKET AT BARODA.—The Chimnabai market (so-called in memory of the late Ranee) is a spacious building measuring 300 feet by 240 enclosing an area of 72,000 square feet. The central portion of this area, covered by substantial iron roofing supported by iron columns, will be devoted to open stalls for the sale of fruit, vegetables, &c. These sheds will be flanked at either end by two storeys of shops opening inwards, in all numbering 52. The upper storey being reached by three stone staircases in each block. The exterior of the shops at either end form the architectural external features, one elevation of which we published in our issue of the 28th May. Since the design was prepared, His Highness the Maharajah has, with characteristic liberality, allowed an additional sum of money for adornments. Gujarati towers surmount the staircases and lead to the upper terraces. These towers are 72 feet high and the general elevation of the façade is 40 feet. The cost will be $3\frac{1}{2}$ lakhs of rupees. The foundation-stone was laid by the Resident, Colonel J. C. Bakerley, in the presence of H. H. the Maharajah, on Saturday, the 28th of May.

ART DECORATING.—It will doubtless be news to our readers to learn that art decorating in its highest form can be carried out in Calcutta and that sufficient encouragement has been met with during the past two years to find employment for two trained artists from home. The City

of Palaces has hitherto been content with whitewash, and where adornment has been attempted it has been of the crudest description. Messrs. Walsh, Lovett & Co., however, with commendable enterprise brought out two trained men from London and after nearly two years' work they have got together a staff capable of turning out decorative work equal to anything in Europe. We have seen a room in their offices which has been decorated as a specimen of what they can do, and we must pronounce the work as simply perfect. We understand that a specimen piece of decorating which was executed in Government House received the entire approval of the Viceroy and Lady Dufferin, and Messrs. Walsh, Lovett & Co. are now engaged on the decoration of the South Ball Room. The firm have also in hand the decoration of Belvedere as well as minor work elsewhere. From what we have seen of the style of this work, we can prophesy its general adoption in all buildings of any pretentions, whether public or private.

Chak Nizam Bridge over the River Jhelum.—This 5' 6" gauge railway bridge is across the river Jhelum at Châk Nizam on the Sind-Sagar Railway. It has been completed within but little more than two years of the date of commencement of operations, in the face of many difficulties which have had to be encountered during its construction. Some particulars of the structure have already appeared in this Journal. The Governor-General in Council records his entire satisfaction at the skilful and expeditious manner in which this important Engineering work has been brought to a successful completion, and offers his special thanks to Messrs. F. L. O'Callaghan, F. R. Upcott, and J. Ramsay, who have successively held the post of the Engineer-in-Chief of the Sind-Sagar State Railway, for the ability and energy displayed by them in connection with the erection of the bridge. His Excellency also desires to cordially acknowledge the services of the other officers who have from time to time been engaged on the work, *viz.*, Messrs. T. R. Wynne, Executive Engineer, 3rd grade; J. Tait, Executive Engineer, 3rd grade; J. E. N. Boydell, Executive Engineer, 3rd grade; W. H. Cole, Executive Engineer, 4th grade, sub. *pro tem.*; W. Nathan, Assistant Engineer, 2nd grade, as well as the subordinate staff.

The Darjiling Railway.—This remarkable little line of 2ft. gauge climbs the lower slopes of the Himalayas and connects the great plain of Bengal with the mountain sanitarium, Darjiling. The line rises 6,919ft. in 40½ miles, an average rise of nearly 172ft. per mile. In this distance 16½ miles are on a continuous average grade of 182ft. per mile. As originally laid out, 12 miles of the road (much of which followed a highway) was laid out with grades of 264ft. per mile and curves of 43ft. radius, but the worst gradient is now 188ft. per mile, and with four exceptions, the worst curves are now 70ft. radius. The cost of the whole line, 51 miles long, has been Rs. 28,00,000. As this includes rolling stock, the figure is very moderate. The locomotives have 10in. × 14in. cylinders and weigh 24,000lbs. in working order, with tank containing 390 gallons of water. It is proposed to use twin engines, coupled back to back. The freight cars weigh 2,000lbs. and carry 8,000lbs. The passenger cars vary in weight from 900lbs. to 2,400lbs., the diameter of the wheels being 18in. The line has four loops or spirals and five reverses or switchbacks. The maximum super-elevation of the outer rail is 2¾in. The traffic for over five years was worked round a curve of 42·6ft. radius, extending over more than a half circle, on a gradient of 165ft. per mile. Such a combination of narrow gauge, steep gradients, sharp curves, and small cars is probably unique, and does credit to those connected with the enterprise.

The Naihati State Railway.—Something ought to be done about the Naihati Railway. The permanent way is in such bad order, that the Consulting Engineers Branch are supposed to have had many qualms of conscience in allowing a maximum speed of ten miles an hour. If things go on as they are at present, the line will have to be converted into a horse or bullock tramway. Either event would not damage the present speed to any serious extent. We hear that 70 per cent. of the sleepers are rotten, and that in other respects the road is in a most disgraceful state. Meanwhile, the powers that be are discussing whether the line should be carried on as a four feet gauge line or not. Why this particular gauge was selected we are unable to say, but most people are aware of the fact, that the Brussels Railway Conference definitely decided that the suitable gauge for a feeder line of secondary importance was the metre gauge. If the authorities consider the Naihati line important enough, by all means keep it up on the 5' 6" gauge; if they consider it to be a secondary feeder line (and here most people will agree with them), let them reduce it to one metre in width. But to introduce another gauge which is neither flesh, fowl, nor good red herring, is simply absurd. The line has now got into such a state, that the reconstruction or closure of it are the only possible policies, and we trust (if reconstruction be decided upon) that the authorities will reduce the line to the metre gauge. This would be both the best and the cheapest thing to do.

The Chief Engineership of Bengal.—Some time ago we referred in our columns to the probable retirement of Colonel C. M. Browne, Chief Engineer of Bengal, on promotion to the rank of Major-General. Colonel Browne has since been promoted temporarily to the 1st grade of Chief Engineers, but is not thereby entitled to remain in his present post. To be so entitled, he will have to be gazetted either substantive *pro tempore*, special, or permanent 1st class Chief Engineer, before he gets his step as Major-General. If this does not take place, he will have to retire from the Public Works Department under the existing rules, and then the interesting question arises—Who is to succeed him? Until the recent appointments in the Government of India were made public, we always believed that Mr. Horace Bell had the best chance, but under present circumstances it is quite possible that Colonel Luard would accept the Chief Engineership, if it were again offered to him. We say "again offered" because we understand that the appointment was offered to Colonel Luard but declined, probably because he hoped to obtain the post of Director-General of Railways. Colonel Conway Gordon's appointment, however, will have some influence on the decision which Colonel Luard may come to in the matter, and we have reason to believe that the Bengal Engineers would be glad to have him at the head of their Department if Colonel Browne is obliged to retire. Mr. Horace Bell is much junior to Colonel Luard, otherwise he would have had a good chance of the appointment.

Current News.

Lieutenant J. R. L. Macdonald, R.E., will have charge of the detachment of Sappers going to Lundi Kotal.

The proposal to take a railway to Chaman over the Kwaja-Amran range has first to go home for sanction.

Mr. A. Anderson, District Engineer, Lucknow, has been transferred to Unao. Mr. Perks replaces Mr. Anderson.

It has been decided, we hear, that Chudderghât is to have a Town Hall, which will probably be erected in the public gardens.

Lieutenant Glanville, R.E., has been granted a gratuity of one year's British pay as compensation for a wound received in Upper Burma.

In the case of Agabeg *vs.* Chater, the decree of the Judge of Burdwan in favor of the defendant has been upheld by the High Court, and the appeal dismissed with costs.

The duration of the lease of the ruby mines to Messrs. Streeter and Company has, we understand, been definitely fixed at five years, commencing from the 1st November next.

The railway bridge on the Ganges at Benares connecting the East Indian with the Oudh and Rohilkhand Railway has been opened for the use of foot passengers from the 15th instant.

Mr. R. R. Bayne, Personal Assistant to the Chief Engineer, East Indian Railway, proceeds to Europe on leave for eighteen months. Mr. Bayne's junior in the office acts for him during his absence.

The Bombay Municipal expenditure is shewing a very decided upward tendency. In 1883-84 the actual expenditure was Rs. 37,15,812; in 1884-85, Rs. 38,81,020, and in 1885-86, Rs. 40,66,940.

We learn that Mr. Charles Baldray, of the Tank Maintenance Department, succeeds the late Mr. J. Hennessey, as Superintendent of the Technical Branch of the Public Works Department, Madras.

The cost of converting the Rajputana Railway into a broad gauge is found to be more than a new line cut direct across from Guzerat to the Punjab would be. It is, therefore, possible that the new line will be made.

We hear that a few more Overseers, with promotion of a step higher for this special service, have been deputed to Upper Burma to carry on surveying operations for the purpose of constructing roads there.

Before embarking for the Gulf, Colonel Smith paid a flying visit to Simla, where it is understood the question of reorganizing the Indo-European Telegraph Department was discussed, and some considerable changes decided upon.

Mr. Beeby, an upper Engineering subordinate of the Tank Division, has been selected to succeed Mr. C. Baldray as Manager of the Head Office at Madras of the Tank Maintenance Scheme Branch of the Public Works Department.

Mr. H. R. P. Carter left Madras for Europe, having obtained three months' privilege leave. Mr. H. C. West, the Acting Deputy Chief Engineer, will act for Mr. Carter during his absence, and Mr. Wilkinson will take the place of Mr. West.

On the recommendation of the Locomotive Superintendent, Madras Railway, gratuities equivalent to six months' wages have been awarded to two Railway employés who have been in the service of the Company for upwards of twenty-five years.

Dr. Schlich, Inspector-General of Indian Forests, does not return to India, so Mr. Ribbentrop will be shortly confirmed in that appointment. After confirmation Mr. Ribbentrop takes three months' leave to England in August, Major Bayley officiating.

The shears will shortly be applied to the Oudh and Rohilkhand Railway Locomotive and Carriage Department. A correspondent states that this contemplated step will throw out of employ no less than, it is believed, 1,000 labourers. This is certainly very unfortunate.

The Queen's statue, which is a Jubilee offering to Madras, is about six feet high and weighs a little over two tons. It is a copy of the statue at Windsor and was executed in London, under the superintendence of the sculptor, Mr. J. E. Boehm, at a cost of £1,700 sterling.

In order to bring the Sind-Sagar Railway into direct communication with the main line of the North Western system, it is contemplated to bridge the river at Multan. This would materially increase the strategic value of the frontier railways, east of the Indus.

Owing to the difficulty experienced at present in securing a suitable officer as head of the Tank Maintenance Scheme Branch of the P. W. D., Madras, it has been decided that, till the appointment of an incumbent, Mr. Hayes, Executive Engineer, shall be in charge of the head office.

Captain Hext, R.N., Director of Marine, will shortly arrive in Calcutta to enquire into certain matters in dispute between the Kidderpore Dockyard authorities and the Port Trust, relative to the buildings to be erected by the Port Trust in place of those given up by the Dockyard for the requirements of the docks.

Government has been even more prompt in the matter of the Châk Nizam than of the Ferozepore Bridge, in its thanks to the officers engaged in its construction. This will doubtless give General Browne's friends another opportunity of asking when he is going to get *his* thanks for the Pishin Railway. Not just yet, we fear.

On a subsequent representation, a further grant of five lakhs is to be made to Provincial Funds, on account of irrigation works, in the current year's Budget of the Madras Presidency. The major part of this sum will be utilised by the Tank Maintenance Scheme Branch of the Public Works Department, whose operations are to be extended, modified and systematised.

The milling machinery at Rangoon, Tounghoo, and Thayetmyo, and of any other mills that may be erected in Upper Burma, will be periodically inspected by an engineer of approved ability, who has obtained a first class-certificate under section 4 of the Burma Steam Boilers' and Prime Movers' Act, 1882, or by any competent person with the concurrence of the Inspector-General of Ordnance.

As the Tirupetty (Ranigunta) to Nellore section of the Cuddapah-Nellore State Railway has been completed, it is to be inspected next week by an officer of the Consulting Engineer's Department, in view to its being passed for public traffic, if the requirements laid down by the Government of India have been complied with. The line will probably be worked by the South Indian Railway.

The Nizam's G. S. Railway have made great progress in the construction the other side of Warrungal; the line has reached Yellendilapad, which being interpreted means Singareni, the future Newcastle of India (?) from which place a lot of coal has just arrived to be tried on this Railway by the Loco. Department, and if approved of, it will probably come into general use, superseding wood as fuel.

Colonel C. J. Smith, R.E., the Consulting Engineer for Railways, will confer with the Agent and with the Chief Engineer of the S. I. R. in regard to the distribution of the additional staff recently sanctioned for the service of the South Indian Railway Company. The alteration of the permanent way by replacing the present 40lb. rails by 50lb. rails will also be taken into consideration.

Mr. J. H. E. Hart having been granted privilege leave, Mr. J. E. Whiting, M.A., M. Inst. C.E., will act as Chief Engineer for Irrigation and Superintending Engineer, C. D. Mr. A. Hill will act as Executive Engineer, Nira Canal. The duties of Joint Secretary to Government, Public Works Department, Irrigation, will be performed by the Secretary to Government, Public Works Department, during Mr. Hart's absence.

The Government of India have sanctioned at Government cost a topographical survey of the Native States of Travancore, Pudukota, and Cochin, and the survey party that has been employed in the Madura district has been told off for this work. The existing survey was made nearly 70 years ago and is very imperfect, some of the mountainous tracts of Travancore and Cochin being still absolutely blank, so that there will be much original work to be done.

There seems a very distinct consensus of opinion among the authorities of the Survey Departments that natives are unfitted for the higher executive appointments. Colonel Haig, Major Sandeman, Colonel Coddington, and Mr. Pemberton all gave evidence to this effect before the Public Services Commission at Simla, on Friday. At the same time they were all agreed that natives do excellent work in the subordinate posts of the Survey Department.

A deputation from the Karachi Chamber of Commerce waited on the Commissioner in Sind on the subject of the Hyderabad-Pachpadra Railway in the early portion of last week, and were received with favorable and marked attention. The deputation was assured that their object had the sympathy and good wishes of the Commissioner, who will forward the Chamber's memorial with his recommendations, through the Bombay Government, to the Government of India.

Considerable interest is felt at home as to what the Government will do with the Oudh and Rohilkhand system of railways which they have given notice of their intention to purchase. Opinion on this side is divided as to whether the administration should be recognised and a smaller guarantee than five per cent. allowed, or whether the Oudh system shall become absorbed into that of the East Indian Railway. The final decision will, however, largely depend upon the recommendations that reach this side from Calcutta.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

"R. E.s AND C. E.s."

SIR,—With reference to the paragraph in INDIAN ENGINEERING of 28th May, regarding *asking* or *ordering* R.E.'s to perform military duties, it may not be generally known that in May 1885, when Colonel Lindsay was obliged to go home suddenly, Major Gracey, R.E., was *asked* to take his place as Engineer-in-Chief of the Bolan Railway, a purely military work, which was being paid for by the Military Department. He refused to go!

The *Civilian* who was eventually *ordered* to go was one whose covenant did not oblige him to serve out of Bengal, yet he was *ordered*.

Although Major Gracey's refusal gave rise to some severe comments in Simla at the time, it did not prevent his promotion a few months later to Superintending Engineer.

VERITAS.

FROUDE'S CURVE OF ADJUSTMENT.

SIR,—There is nothing wrong in Froude's method, but the errors are imagined by "F. E. R."

The two circles cannot have a common tangent at the points where they touch the curve of adjustment—as drawn by him.

The points E and E′ in his figure should have been placed further round the circles towards D and D′—so that the curve of adjustment falls entirely between the tangents.

With regard to the second difficulty, only half the curve of adjustment should be set out around each circle. Then $x=\frac{a}{2}$ in the limit, and $y=\frac{b}{2}$ as directed by Rankine.

In the case of curve leaving straight, half the curve of adjustment should, of course, be laid back along the straight.

J. C. M.

DEHRA DUN RAILWAY.

SIR,—I wish to call attention to the shabby way in which the local Association is being treated by the Local Government. We are not now asking, knowing it is useless, for any guarantee from Government, but merely for the land, and right to charge higher rates and fares than usual (though much below the present cost of carriage by road), and if only we can get the Government stamp on our estimates of cost and profit, we mean to try to raise the capital for the line, and as it promises to pay at least 7 per cent, we think we may be able to do it. But we must first have the Government stamp on the estimates, and we have been fighting for this since October 1885. The promotion of the line has been going on since the end of 1879, and it was entered by Government, in Schedule B, as a paying railway, to be constructed by private enterprise.

Ours is about the only attempt that has ever been made in India to get up a railway without a guarantee of some sort, and as, if successful, it would lead to many more such enterprises, it ought to meet with every encouragement from Government, instead of the hindrances we experience. The Local Government has had our plans, estimates and report since October 1885, and yet they won't let us see those prepared by their own man, Mr. Hunt. And they wouldn't have made the survey without pressure from the Government of India. Mussoorie is not a seat of Government, and therefore, Government do not trouble themselves to encourage a railway to it, though the traffic is many times that up to Naini Tal.

C. W. H.

Dehra Dun.

THE BENGAL-NAGPUR RAILWAY JUNCTION.

SIR,—In your paper you say that Asansol is likely to be chosen as the point of junction between the E. I. R. and the Bengal-Nagpur Railways.

With reference to this subject will you kindly permit me to point out that by having the junction at Asansol the Bengal-Nagpur will have to construct a very expensive bridge over the Damuda—find labor scarce and dear—find land expensive, and it will open out no new business centre till probably it reaches Purulia.

On the other hand, if the junction is made at Govindpur, on the Grand Trunk Road to Benares, the crossing of the Damuda will only necessitate a moderate sized bridge, or may be, the crossing could be effected by tunnelling under the bed of the river, in a place where the river narrows, and there are rocks.

The line would also go across a new coal field, utilising the old Hazaribagh road till the Damuda, and catch up the Asansol to Purulia alignment at Raghunathpur. The country is there full of material, labor plentiful, and the railway could have its own collieries, leaving the Raniganj field and its propietors without a plea to grumble and growl, in the matter of preference being shewn to this or that Company. Over and above this land is cheap.

The East Indian Railway are at present about to extend their line across the Barakar; thus, if the Bengal-Nagpur has its junction at Govindpur, it could with ease utilise the G. T. Road to meet the E. I. R. at any point where the E. I. R. make their new terminus, or they might induce the E. I. R. to carry on their line to Govindpur. In either case the Bengal-Nagpur at Govindpur will be right in the line of pilgrim traffic from Parisnath to Puri and create a great business centre. Working telescopically, the Bengal-Nagpur could utilise its own coal as the work of construction goes on. One or two large quarries would supply enough coal to keep the Company going at starting, and by that alone they would save about Rs. 3 per 100 maunds on all the coal they need.

If you will look at the Geological Map and strike the Damuda about due south from Giridhi, you will see the advantages I point to.

The Chamber of Commerce, unless it wishes to favor the existing Coal Companies, ought to recommend Govindpur as the junction of the lines.

A.

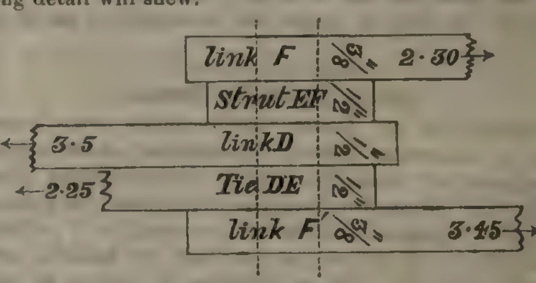
GARSON'S PATENT SUSPENSION BRIDGE.

SIR,—I did not reply to Messrs. A. and J. Main's letter in your issue of 23rd April, because there was really nothing to say—the two first points were explained, and as regards the third, I had already pointed out that the shearing strain is not the critical point with pin joints, and there was no need to waste your space by repeating my objections.

I must, however, reply to their letter in yours of 4th June, because they say "he ventures to criticise the method of packing the bars on to the pin, without having seen any detail drawings, and shews a diagram which is absolutely misleading, assuming also in a free and easy sort of way that such packing would probably be as good as any other."

Now this is hardly fair; I said the drawing published did not shew the packing, and not being able to see any way of packing so as to obtain an equal strain on the last links, proceeded to point out this fact as something to be noted in designing pin joints, using what appeared to me the best arrangement, but I am quite open to correction on this point, as a better arrangement may be possible.

That put forward with such confidence by Messrs. Main, in the letter under reply, is, however, worse in every respect, as the following detail will shew.



The letters in the above diagram refer to the original bridge diagram.

The total strain in links, F, F′ is, according to that diagram, 5·75 tons.

Of this, 3·5 comes from link D, and 2·25 from tie D E. There is no strain from strut E F in the plane of links F.

We have then, the loads shewn in diagram.

Of that on link D, half is obviously carried by F, and half by F′ = 1·75 tons on each.

Of that on tie D E, $\frac{23}{30}$ is equally obviously carried by F′, and $\frac{7}{30}$ by F, being 1·70 and 0·55 tons respectively, or a total on the bars F′, F of 3·45 and 2·30 tons—whereas the packing I proposed gave a distribution of 3·26 and 2·49 tons.

Therefore I, as a practical man, prefer my own arrangement, unless there is an error somewhere which has not been pointed out.

But with this arrangement also, the bending moment on pin is far worse, which is not surprising, as Messrs. Main only take shear into consideration.

The bending moment from link D *alone* is $\frac{3·5 \times 1·875}{4} = 1·64$ inch-tons, which with 0·1 from load on D E makes a total of 1·74 inch-tons, dividing which by 0·1398, the modulus of resistance of a $1\frac{1}{8}$ pin, we get 12·4 tons per square inch on pin as against 10 by my arragement.

As we have now the detail of packing adopted by the makers, the case lies in a nut-shell: there is either an error in my calculations which can easily be shewn, or they subject the pins of their bridges to a stress of 12·4 tons per square inch as a proper working load, together with a bearing stress of 8·18 tons per square inch.

It is clear, however, without entering into detailed calculations that they have never considered the subject of a pin being under a bending strain, for they place the heaviest load in the middle of span and say "there will *then* be no disadvantageous bending stress on the pin," whereas it can be seen at a glance that this is absolutely the worst arrange.nent possible, so far as the pin is concerned.

F. E. R.

Literary Notices.

REPORT ON THE METHODS OF WORKING THE THICK COAL OF STAFFORDSHIRE,—TO SIR A. M. RENDEL, K.C.I.E., CONSULTING ENGINEER, EAST INDIAN RAILWAY COMPANY,—*By Walter Saise, D.Sc., F.G.S., Associate, Royal School of Mines; Manager, East Indian Railway Collieries.* London; Hutchings, 38, Hutton Street, Whitefriars, E.C. 1887.

WE have been favored with a copy of this Report, which contains little that is new and less that is original on the subject of which it treats. The matter is exhaustively discussed by André and other authorities on Coal and Coal-mining.

Considering Dr. Saise's opportunities, the Report must be considered, by those qualified to judge, as disappointing.

JOURNAL OF THE ROYAL STATISTICAL SOCIETY. March, 1887.

PART 1 of Vol. L of this well-known "Quarterly" opens appropriately with a copy of the Charter granted the Society on the 31st January 1887, since which date it will be distinguished by the prefix "Royal."

Mr. Price's Paper on Sliding Scales in Wage Arrangements is an attempt to shew the diversity of character in Economic and Industrial Reform and a possible means of the possible settlement of strikes and kindred disputes. We agree with the writer that there is no uniform method which can be applied with certainty of success in all industries and to every dispute, and hold that Boards of Arbitration and Conciliation are factors favoring Peace in such difficulties between employers and employed.

Professor Nicholson of Edinburgh discusses the variations in the Monetary Standard as a purely Statistical problem. The inquiry is in the main on the theoretical side; "causes" and "consequences" being left for subsequent treatment.

Among the Miscellanies we find some interesting particulars regarding the Fires in London during the year 1886. It is instructive to learn that one-third of the Fires that occur in the British Metropolis are due to causes "unknown," while one-fifth of them are ascribed to lamps and one-tenth to gas in various ways.

ASIATIC SOCIETY OF BENGAL.

THE Proceedings for March (1887) contain some interesting remarks by Lieutenant-Colonel Waterhouse on the application of the principle of what is known as orthochromatic photography. By this process the photographs are taken on gelatine dry plates specially prepared so as to be more sensitive to yellow light than the ordinary dry plates, and, in fact, by suitable arrangements, plates may be made as sensitive to yellow as ordinary plates are to blue. Such plates are of the greatest use in copying paintings and other coloured objects with a truer rendering of the light and shade as seen by the eye than is possible by the ordinary plates. Being so sensitive to yellow light photographs can be taken with them by petroleum or gas light and, in some instances, with very great advantage. In order to produce this sensitiveness to yellow the photographic film of bromide of silver is stained with certain dyes, which increase the sensitiveness of the film for the less refrangible rays of the spectrum. Among them chlorophyll, cyanin blue, eosin and its derivatives, especially those with a bluish tint, such as erythrosin, an alkaline salt of tetraiodfluorescein. Colonel Waterhouse says that, the illuminations and fireworks on the occasion of the Jubilee seemed to offer a good opportunity of testing the sensitiveness of these orthochromatic plates to the yellow light given off by the myriads of little *chiraghs* used in this country for illuminating. The results were on the whole fair. He also mentions that these plates have been found very valuable in photomicrographical researches for photographing stained preparations, and will be useful for many other purposes where a better representation of the so-called non-actinic colours is required than can be obtained on ordinary plates.

THE UNITED SERVICE INSTITUTION OF INDIA.

The Journal for April contains an article on "The Formation of a Railway Service Corps from the North-Western Railway," by Lieutenant A. C. Yate, 27th Bo. N. I. The gist of the writer's contention is embodied in the following excerpt:—

The primary object of the Railway Service Corps of the North-Western Railway is the working of the line in all its branches, and the security of such portions of the line as run through tracts of country that are inhabited by turbulent tribes who are as yet more or less unsettled and unreconciled to the rule of the Indian Government. Such for example is the portion of the line from Sibi *viâ* Harnai and Kach to the Pishin, and such might be the line from Rindli *viâ* the Bolan to Quetta. The outbreak among the Marri and Pathan tribes, on the former line that ensued on the evacuation by our troops of the Harnai route, consequent on the defeat of Maiwand in July 1880, is an instance of what might recur at any time in the immediate future. Only so recently as last year a scare broke out among the employés on the Sind-Pishin Line now under construction, and many of them deserted their posts. The formation of a Railway Service Corps from trained soldiers of the reserves, both British and native, may be made conducive to the prevention of the recurrence of any such scares—scares that in the time of war and external danger to India might be disastrous if not fatal. In the event of any attempt on the part of Russia to invade or even threaten India, the occurrence of a panic on the lines of railway that would feed and supply our army of defence would be most inopportune. But while the primary object of the Railway Corps would be the satisfactory working of the line and its defence from internal danger, it is also quite possible that it might be called upon to furnish Railway Artificer Companies for the rapid construction of a line or lines of railway for strategic purposes, as, for instance, a line from the Pishin or the Khwaja-Amran range to Kandahar and Girishk, or from some point on the North-Western Frontier towards Kabul, or across the Beluch desert to the Helmand. As the construction and management of telegraph lines is also intimately connected with that of railways, and as in modern warfare telegraphic communication is essential to the success of military operations, I hold that a certain proportion of the staff of the North-Western Railway Service Corps should be trained as telegraphists both for working and construction.

The proposals furnished for giving effect to these views are of a very elaborate character, teeming with details, but we are disposed to think that their *application* would be beset with such difficulty as to render the scheme impracticable—except in a considerably modified form.

New Books and Reprints.

GEOLOGY, MINERALOGY, MINING.

Dana (James D.) Manual of Mineralogy and Petrography. 4th ed., Revised throughout and Enlarged, Post 8vo, pp. 510. *Trübner* 8 6

Pumpelly (R.) Report on the Mining Industries of the United States (Exclusive of the Precious Metals). With Special Investigations into the Iron Resources of the Republic, and into the Cretaceous Coals of the North-West. By Raphael Pumpelly. Illustrated. 4to, pp. xxxvii—1,025. *Washington.*

Woodward (H. B.) The Geology of England and Wales. 2nd ed., thoroughly Revised and Enlarged, with New Map. 8vo. *Philip and Son* 18 0

SCIENCE.

Proceedings of the American Association for the Advancement of Science. Thirty-fourth Meeting, held at Ann Arbor, Mich, Aug. 1885. 8vo, paper, pp. 95-567. *Salem* 9 0

TRADE, COMMERCE AND MANUFACTURE.

A B C of Modern Dry Plate Photography. 2nd ed., Revised and Greatly Enlarged. Post 8vo, pp. 146. *London Stereoscopic Co.* 1 0

Corfield (W. H.) The Treatment and Utilisation of Sewage. 3rd ed., Revised and Enlarged. By the Author and Louis C. Parkes. 8vo, pp. 530. *Macmillan* 16 0

Foxwell (Herbert Somerton.) Irregularity of Employment and Fluctuation of Prices. With Two Diagrams. 12mo, sd., pp. 96. *Co-operative Printing Co.* (Edinburgh). *Simpkin* ... 0 6

Garcke (Emile) amd **Fells** (J. M.) Factory Accounts: Their Principles and Practice: A Handbook for Accountants and Manufacturers. With Appendices on the Nomenclature of Machine Details, the Income Tax Acts, the Rating of Factories, Fire and Boiler Insurance, the Factory and Workshop Acts, &c.; including also a Glossary of Terms, and a large number of Specimen Rulings. 8vo, pp. 236. *Crosby Lockwood* ... 10 6

Pearce (J.) The Merchant's Clerk: An Exposition of the Laws and Customs regulating the Operations of the Counting House. 14th ed. 12mo, pp. 122. *E. Wilson* 2 0

Sansone (A.) The Printing of Cotton Fabrics; comprising Calico Bleaching, Printing and Dyeing. 8vo, pp. 380. *A. Heywood* (Manchester). *Simpkin* 15 0

United States. Bureau of Statistics. Annual Report and Statements of the Chief of the Bureau of Statistics on the Commerce and Navigation of the United States for the Fiscal Year ending June 30th, 1886. Foreign Commerce, Immigration and Tonnage. Part I. 8vo, pp. cv—938. *Washington.*

Unwin (Wm. Cawthorne.) Exercises in Wood Working for Handicraft Classics in Elementary and Technical Schools. Folio, bds. *Longmans* 4 6

Wood (H.) Natural Law in the Business World. 16mo, pp. 222. *Boston* 4 6

General Articles.

THE MADRAS HARBOUR.

Its Construction, Destruction, and Reconstruction.

XIV.

(Concluded from page 364.)

Mr. Parkes' final report is a long one, and it is accompanied by several pages of statements of past, and estimates of future expenditure, and by a plan and a sheet of sections which we give as Plate VI. Mr. Parkes said that, while accepting the first report of the Home Committee as his "implied instructions," the proposals he now submitted were the result of a careful reconsideration of the existing state of the works, based on records of later date than the Committee had before them, and aided by personal conference with Mr. Thorowgood, and that the details of the work had been independently designed. Where his conclusions differed from those of the Committee, he had carefully investigated the grounds of difference, and where he thought there was reason for doing so he had not scrupled to increase the dimensions given by the Committee, and to introduce some additional precautions. This philosophical and judicial method of preparing a revised project was much to be commended; but it is curious that while the sections adopted by Mr. Parkes are strikingly like section No. 4 recommended by the Home Committee, they are still more strikingly *unlike* the revised section *so confidently* recommended by himself in March 1882. Notwithstanding the protection given seaward by the ruins of his old work and the 40 to 45 feet thickness of random blockwork, in the matter of bond Mr. Parkes has outdone the Committee.

For the elbows and sea-faces it will be observed from the drawings that Mr. Parkes adopted the plan of retiring the new work behind the ruins of the old one, as the Home Committee suggested should be done in the event of it being found difficult to keep to the old alignment; and in his report he states that he increased the distance at which that Committee proposed to place the new pier from the old one by 9 feet, in order to avoid the overthrown blocks and having to build also on the old rubble. The new building, he said—

will be of the same general character and dimensions as its predecessor, but there will be some modifications of detail. The original building consisted of two independent walls placed in contact, but not tied together. It is recommended that for the future the blocks should be bonded together, so as to form one wall, and in this recommendation I concur. The unbonded system has great advantages in comparatively shallow water, in which the waves have little effect on the blocks themselves, but much on the foundations, while in deeper water the action of the sea on the foundations is less, but that on the blocks themselves is greater, and this fact turns the scale in favor of bond for the outer portions of the piers. At the same time the bond rather increases in some respects the difficulties inseparable from a compressible foundation, and new difficulties are introduced by the special circumstances of the case.

But even with the precaution of removing the old blocks and increasing the distance from the old work, there will still be a greater liability than there was in the original work to unequal settlement. The sea-side of the new building will still partially rest on the old rubble, which has been consolidated by four or five years' exposure to the sea. The new rubble will be in the same position as the old was when first built upon, that is, it will be liable to be compressed to the extent of a foot or 18 inches within a few hours after the weight of the blocks is placed upon it, and to a slower settlement subsequently extending over months, and perhaps years. This latter slow process of settlement, however, is not injurious to the work. But the first is so; it subjects the blocks to great and irregular strains, and is, I think, the most fruitful cause of many of the original blocks having been broken. The evils would be materially aggravated by the fact of one side being more liable to settlement than the other. It is, however, possible materially to reduce these evils, if not to prevent them altogether, and it is proposed to do this by subjecting each length of bed after it is prepared by the divers, and before the blocks are set to a compression rather greater than that of the blocks themselves. This will be accomplished by placing in front of the work a pile of iron (old rails), with the interstices filled up with cheap cast-iron bars, covering the same area as a row of blocks, and having a weight rather greater than that of the blocks. This "compressor" will be moved forward in advance of the building by the titan. If, after its removal, it is found to have compressed a bed unequally, the hollow parts will be filled up with suitable flat pieces of stone before the blocks are set.

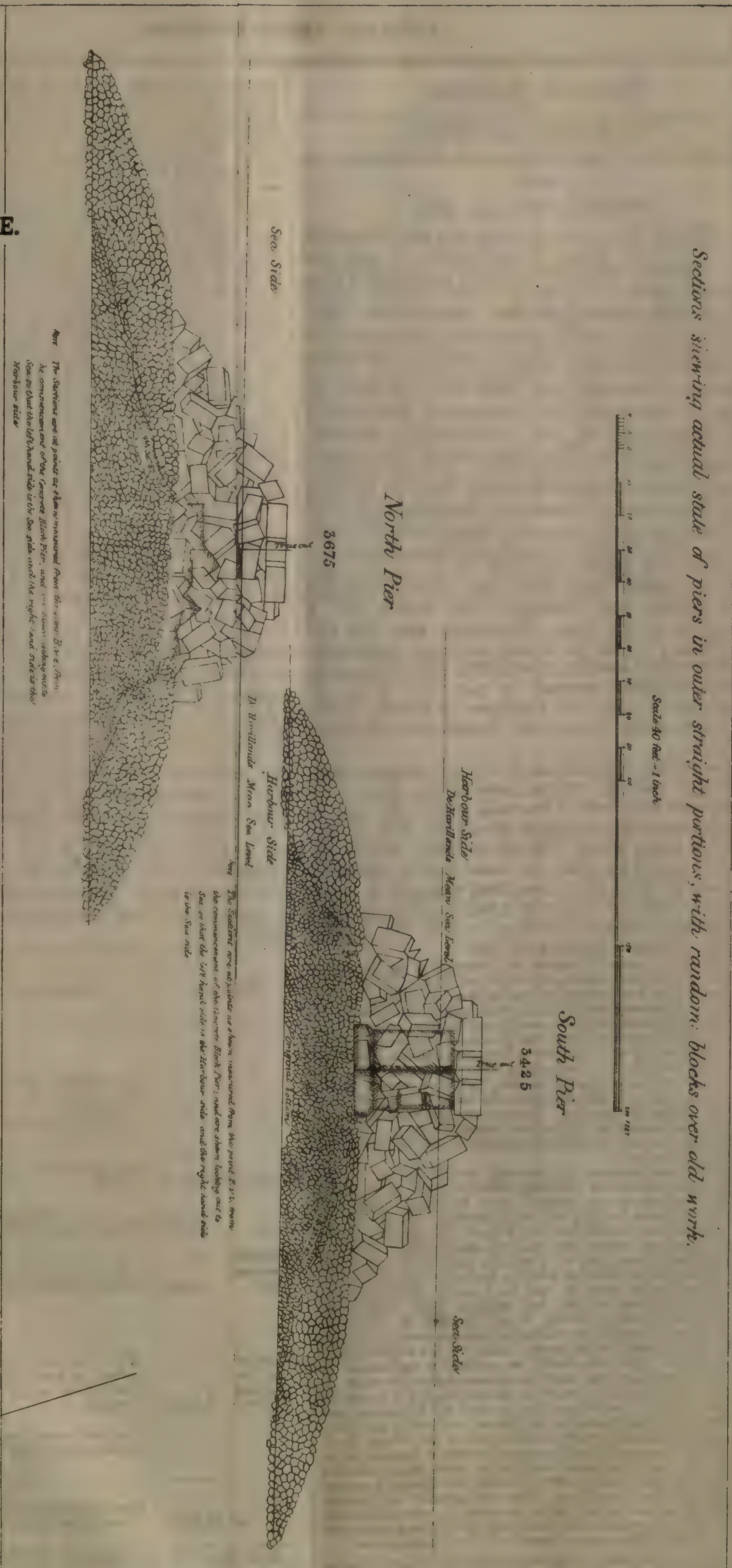
I propose to introduce another departure from the original design, which will also diminish the evils of settlement. In the original work the foundation blocks were 6 feet high, and above this there were three courses of blocks, each 8 feet high, the whole being 4½ feet wide. It is intended now to use blocks 6 feet high and 6 feet wide, of which there will be five courses, including the foundation course. These blocks will be stronger than those 4½ feet wide, and less liable to break. There is also the incidental advantage that the iron compressors would have to be advanced in stages of 6 feet instead of 4½ feet, and this would accord better with a fair rate of progress of one row per day. It will be seen by the cross sections that the foundation course consists of two blocks of equal length (each 14 feet), the upper courses of blocks of 14 and 10 feet alternately breaking joint. Thus, the foundation course will not be bonded. The reason for this is that there would be practical difficulty in manipulating both the 16 feet and the 12 feet blocks in that situation. I pointed out these difficulties to the Committee, and obtained their concurrence to this small departure from their recommendation. The importance of bonding is greatest in the top course, and diminishes in descending. In the bottom course it is practically *nil*. The blocks will be further locked together by means of a projection on the top of one block fitting into a corresponding recess in the bottom of the block above. This principle was adopted in the original work, and was certainly successful in preventing the blocks from sliding on one another, as they had been found to do at Karachi and elsewhere. In the present case a connection of a similar kind will be made between the ends of the 14 feet blocks on one side with the ends of the 14 feet blocks in the courses above and below on the other side, which overlap them, and there will also be hollows and projections on a somewhat similar principle in the backs and faces of the two top courses, thus giving additional ties throughout the whole width.

Mr. Parkes retained the bent rail tie he had formerly proposed for the top courses, but dispensed with the Committee's cramp for the course below it. The new wave-breaker blocks were to be 9 feet × 9 feet × 6 feet, and to weigh 30 tons each. The last 200 feet of the new piers, including the portions facing the entrance, would be made 38 feet wide, instead of 24 feet, and be founded 12 feet lower than the parts within the Harbour, or 34 feet below mean sea-level, and their toes would be protected by an apron of concrete blocks laid on the foreshore. Mr. Parkes estimated that the works he proposed would require 3½ years from the recommencement of block-setting in June 1885, or till about the end of 1888. The estimated cost was Rs. 45,90,051, including 7½ per cent. for establishment, and 2½ for contingencies. This total included a sum of Rs. 2,96,334 expended between 31st October 1881 and 30th April 1884, but not Rs. 1,54,994, the bulk of the establishment charges during that period, which Mr. Parkes proposed to charge off to the old work. Here is an abstract of his statement of expenditure from commencement of work to 30th April 1884.

Estimates.		Description of work.		Expenditure.
	Rs.		Rs.	Rs.
		I.—Original Design. Expenditure to 30th April 1884 ...	58,56,199	
		Deduct (transferred to IV. and V.) ...	1,98,359	
Sanctioned	56,50,000	Net expenditure on original design		56,57,840
"	2,00,000	II.—Moorings. Expenditure to 30th April 1884...		1,90,589
Submitted for sanction ...	1,54,994	III.—Cost of Establishment. During suspension of works ...		1,54,994
Submitted for immediate sanction	5,00,000	IV.—Gain and loss of Land. Gained 88 acres; lost 41 acres. Total to be carried to debit of account		4,82,114
		V.—Expenditure to be charged against restoration works ...		2,96,334
Rs.	65,04,994	Total expenditure to 30th April 1884, as per official return ...		67,81,871

And here is an abstract of Mr. Parkes' estimate of cost of restoration works.

R.
AL COMMITTEE.



	Rs.	Rs.	Expenditure to 30th April 1884. Rs.
PRELIMINARIES.			
New Machinery, repair, and renewal of old machinery, alteration and extension of block ground, and Railway materials..	......	3,27,529	58,079
NORTH PIER.			
Rubble stone in foreshores and base	3,98,629		
Concrete blocks in built work ...	6,82,707		
Wave-breaker, including cramps and concrete capping ...	9,69,245	......	63,756
Total for North Pier ...	.....	20,50,581	
SOUTH PIER.			
Rubble stone in foreshores and base	3,66,364		
Concrete blocks in built work ...	6,14,133		
Wave-breaker, including cramps and concrete capping... ...	7,95,985	......	63,755
Total for South Pier ...	......	17,76,482	
Materials in store to be debited to work in progress	.....	......	93,436
Establishment 7½ per cent. ...	.....	3,11,594	17,308
Contingencies 2½ ,, ...	......	1,03,865	
Lighting Entrance	.....	20,000	
GRAND TOTALS ..	......	45,90,051	2,96,334

To get at the total probable cost of the Harbour, exclusive of additional outlay on moorings not estimated, and subject to deduction on account of rents and value of land utilised, we must first deduct from the total of past expenditure the sum of Rs. 2,96,334, which is included in the restoration estimate, and then add the balance—Rs. 64,85,537—to the total of the restoration estimate. The grand total is Rs. 1,10,75,589 for a close Harbour containing about 172 acres of anchorage for vessels of from 700 to 4,000 tons each.

The first Madras Committee, of 1868-69, estimated the cost of a rubble stone straight breakwater, 2,000 yards in length, and giving 258 acres of sheltered anchorage, at Rs. 1,06,20,325, or possibly even Rs. 1,33,00,000. Mr. Robertson estimated the cost of such a breakwater, built after design, and on his system, at Rs. 1,31,10,000.

This series of articles has extended to a greater length than was expected at the outset, but it has been found impossible to make it shorter and yet to carry out the original intention, which was to give a complete and fair history of the Harbour works, from their first conception to the sanction of the design for their restoration, as contained in the Blue Book. It has been the aim, and endeavour all through, of the writer to notice every opinion and argument of any practical importance in the order of their utterance and to give as fair, though as concise, a statement of each as possible. His leaning against the design and system of construction which were sanctioned by Government, against the advice of the competent and experienced Engineer whom they had previously consulted, but to whom they strangely omitted to refer the competing design, has not been concealed; but no weight is claimed for that leaning, and Mr. Parkes has been allowed, in these articles, to speak for himself. Mr. Parkes' work was overthrown by Neptune, at whose efforts he had ventured to laugh, and his design for restoring it was set aside by Engineers of greater eminence as utterly inadequate, and in this condemnation he was fain to acquiesce. It is a mystery, therefore, the solution of which will be looked for in vain in the Records which have been published by Government, how, in spite of all this, Mr. Parkes retained his position as Chief Engineer of the works. The Madras authorities, both nautical and engineering, and the Madras public were always sceptical as to the success of a close Harbour with an entrance to the eastward, though at first perhaps they were dazzled with the prospect of its cheapness, and by 1879 the Government of India had lost all confidence in it, and requested the Secretary of State to consult the most eminent Harbour Engineers in England as to its likelihood of success. This the Secretary of State refused to do, but instead consulted Mr. Parkes himself, who had, of course, no difficulty in vindicating his own design. One passage, in Mr. Parkes' Memorandum of 6th November 1879, which we referred to in Article VI. of this series, may, however, contain a clue to the solution of the mystery. In triumphantly concluding his review of "the sand difficulty," he said—"Nor does it seem necesary to enter upon any defence of the positions I took in the earlier stages of the undertaking with regard to some questions then debateable. An imputation of recklessness in drawing conclusions will be hardly entertained against me by the authorities of the India Office, and I have therefore passed over some points, of which the discussion could only take the form of a defence against such a charge. I am confident that my case will not be permitted to be damaged by my reticence in these two respects." Mr. Parkes, then, it appears was in such favor with the India Office that the united force of the Governments in India, both Local and Supreme, could not prevail against him, and he seems to have retained that favor even after the failure of his works, for the question which was debated in 1884, namely,—under what officer, as Chief Executive authority, the restoration of the works was to be proceeded with,—was somehow or other decided in his favor. This question, though, has again recently been raised by the Harbour Board, under whom the works are now being carried on.

These articles have comprised discussions on several important questions of marine Engineering. *First.*—Whether a Harbour, on an open straight line of coast, and sea shore, such as that at Madras, should be formed by a breakwater parallel to the shore, or by arms projecting from the shore and then bent to each other, leaving a narrow entrance directly seaward, or at one or other corner; or, if a close Harbour were adopted, whether the sides of the Harbour should be quite straight and the Harbour be completed by a breakwater parallel to the shore overlapping them; or whether the close Harbour should be disconnected from the shore, so as to allow the littoral currents to carry the sand freely up and down the coast and prevent the foreshore being extended outside the piers and the Harbour being silted up? *Second.*—As regards the section of either work, whether it should be constructed entirely of *pierre perdue*, perhaps with large packing on the top; and if so, what slopes should be allowed for in estimate and construction, and what the height of the crest should be above water: or, whether rubble stone should be used only as a base for a solid ashlar or concrete block superstructure, and if so, what the section of the rubble base should be, what the depth of its crest should be below water, and what sized rubble should be used? Mr. Parkes' important experiment "in Engineering" has gone far to settle these points; but the more recent failure of the Colombo breakwater, which was designed by one of the experts by whose advice the Madras piers are now being so greatly strengthened, tends to shew that *pierre perdue* is altogether untrustworthy as a foundation, and that it should be either trusted in all, at its natural angle of repose under the action of a heavy sea for the whole mass of the work or not trusted at all. *Third.*—If a solid wall, with or without a rubble base, is to be used, how is it to be built,—with bond, and if so, to what extent and how is bond to be given, or is bond to be wholly dispensed with, as in Mr. Parkes' work, and in either case what weight must the blocks have to withstand the force of the sea, and what width must the wall have? *Fourth.*—Whether, especially if a rubble base is to be used, random blockwork is not better than an attempt at a monolithic structure? *Fifth.*—What height above water ought the walls of a close Harbour such as that at Madras to have? *Sixth.*—To what extent is the height of a cyclone sea arriving at a line of coast dependent on the force of the wind at the coast, and, subsidiary to this, whether are sailors or engineers most competent to estimate the height and violence of waves observed by them? *Seventh.*—What were the causes of the failure of the Madras works, as nearly completed as the 11th November? *Eighth.*—What design

was the best, in the circumstances, to choose for the restoration of the Madras Harbour, and does the design that has been adopted promise to prove a sufficient one?

Many other questions of engineering might be named as being involved in the history of the Madras Harbour, but the above seem to be those that have most prominence. It is admitted by almost every one concerned that the Harbour can never be used for purposes of refuge from a cyclone, and that ships using it as a shelter while loading and unloading will not find still water in it during ordinary rough weather, with the entrance facing the east, and also that the entrance is wrongly placed for easy entrance. Moreover, unless a large additional expenditure is incurred for wharfs and jetties, or for docks inside the Harbour, or on the site of the land gained from the sea to the south of the Harbour, very few vessels can be accommodated in it at one time. It can hardly therefore be said that the Harbour when completed at a cost of Rs. 1,10,75,000 promises to be a successful work.

THE BURDWAN WATERWORKS.

BURDWAN has long been noted for its malarial fever, and there were some who went the length of declaring that so far as Bengal proper was concerned, this particular fever took its origin in Burdwan. There were substantial grounds, it must be admitted, for this general belief, the cause of which is not far to seek. The surrounding country was undrained, while the water-supply of the town and its suburbs was got from tanks, which are to be seen scattered about in great number. Every dwelling house of any pretension had one or more tanks, in which water accumulated not only from underground springs, but during the rainy season the rain water flowed into them from all parts, carrying with it the refuse of the roads and commons, and the accumulations to be found in every Indian yard or compound. When it is considered that these tanks were (and are even now) used by the people for bathing purposes as well as for the supply of drinking water, and the accumulations in them festered and fermented during the boiling heat of April, May and June, one ceases to wonder that malarial fever should have been so prevalent in Burdwan. Under these circumstances the value of a pure water-supply must be thoroughly appreciated, and this Burdwan got only about three years ago. The only question that suggests itself is, why the idea never occurred before to the officials of this estate to utilize for this purpose the river which flows within a few miles of the town.

I propose here to give your readers a brief description of the waterworks wich now supply the town with pure drinking water, beginning with the Engine-house, which has been erected at a spot about three miles south of the town, and about one mile from the river Damuda. The Engines are from the foundry of the well-known firm of James Watt, and are of the horizontal piston arrangement, there being a double set with two fly-wheels. One draws up the water from the bed of a canal, which has been cut from the river and passes within a few feet of the Engines, and pumps it up into the reservoir a distance of about a hundred yards; while the other Engine draws the filtered water from the cistern, and forces it out into the main. Both the Engines work simultaneously, and are ten horse-power each, with two ordinary boilers, working up to a pressure of 40lbs. The Engine-house itself is picturesquely built, and everything is kept clean and orderly. The main is a 12-inch one, and up to the present time has been found sufficient for the wants of the people.

The Damuda river is a very muddy stream, and the water, as pumped into the tanks, is simply thick. There are three tanks, all *kutcha*, about 100′ × 60′ × 10′. Below these are two filters, 70′ × 50′ × 5′, and are made as follows:—First a layer of broken bricks and coarse stones, then three layers of gravel and coarse sand and ending with a layer of fine river sand. The water from the tanks is conveyed to the filters by means of a pipe, which rises in the centre of the filters in a sort of wine-glass shaped fountain, over which the water flows, and falls on to a heap of broken bricks below.

The pipe on the tank side has a fine wire gauze nozzle at the end, and is worked by cranes, by which, when it is required to convey the water from the tanks to the filters, it is lowered, and the gauze nozzle dips below the water. This is rather an ingenious contrivance, and prevents the passage of coarse organic matter into the filters. After filtration the water passes into a large reservoir 100′ × 50′ × 10′, whence it is pumped up and forced into the main. The water is not very clear; but this is owing to there being only one set of filters. It may, however, be found possible before long to pass the water through another set of filters before finally pumping it into the main. It is, nevertheless, very acceptable when compared with the water from such questionable sources as described above.

During the rainy season the stream becomes very muddy and the water is in consequence in anything but a desirable condition. At this time rock lime is used to precipitate the mud and organic matter suspended in the water in the tanks, but even with this aid, I noticed the water was very far from clean. Hydrants and drinking fountains have been erected at suitable spots, and the inhabitants of Burdwan have much to be thankful for in possessing a pure water-supply. The source of the water is, as we have said, the Damuda river; but the canal, which has been cut, and which passes within a few yards of the Engine-house, serves other useful purposes. A few hundred yards below the Engine-house, a *bund* and two sets of sluices have been built. One set allows the water to pass under a masonry bridge, and ultimately join the river at a point lower down; while the other set diverts the stream, when necessary, and the water is utilized for irrigation purposes. A house is now under construction for the Engineer in charge of the waterworks, and there is every probability of these works being extended before long. J. H. J.

CALCUTTA PORT IMPROVEMENTS.
THE KIDDERPORE DOCKS
II.
History of previous proposals.

THE next proposal to provide wet docks for the port of Calcutta was that of the Calcutta and Diamond Harbor Railway and Dock Company, and it was referred to Mr. Simms for report. The railway was to be laid along the existing road. The proposed Company had not prepared any definite plan for the docks, but expressed themselves satisfied of the possibility of constructing them upon any plan that might be required or approved of by Government, and their proposed capital, to cover the cost of the railway from Calcutta, with warehouses, buildings and docks at Diamond Harbor, was one million sterling. The site they proposed lay between the termination of the road from Calcutta and the bank of the Hughli and the Hadjipore Creek. It was proposed also to utilise the creek in connection with the docks, by constructing a dam or an entrance lock near its mouth. In constructing the railway the Company proposed to excavate a canal on one side of the road, for the purpose of widening the embankment, the canal to serve as well for a drain as to allow lighters to pass along to Tolly's Nala with the heavier freight from the docks, and with the produce of the district; and they asked for a free gift of the road and necessary land, and for power to levy a toll on boats using the canal.

In his report, dated 21st January 1847, which is careful and long, Mr. Simms pointed out that, besides being advisable as providing shelter from storms, the "bore," and the current during the freshes, docks were the sure remedy against plunder and fraud to an enormous extent. "This system of plunder, or river piracy,"

he said, "is not peculiar to Calcutta; it exists in all ports, and has only been subdued or annihilated by enclosing the ships, with their export and import cargoes, within lofty dock walls, allowing of ingress and egress only through certain well-guarded gateways. To such an extent was the system carried in London, that its prevention led to the construction of the first public docks at that port, and was the chief argument adduced before the Parliament to obtain legislative sanction to that project." Assuming that docks were a desideratum for the port (a fact of which he was most strongly convinced) Mr. Simms said the question to be determined was the most suitable site for them, whether at Kidderpore, as proposed by the Committee whose report has been referrred to in a previous article, or Diamond Harbor, as proposed by the Company, and after weighing all the *pros* and *cons* he said that all arguments adduced by the Wet Dock Committee, in their report of 1st May 1846, in favor of docks were applicable to the scheme he was reporting upon, and the whole therefore appeared to resolve itself into a question of site—whether Kidderpore or Diamond Harbor was most eligible for the purpose, and he came to the conclusion that the one site possessed no great advantage over the other. The Company had estimated for a profit of 20 per cent. on their capital: Mr. Simms followed the Committee of 1846, in estimating the profit to be derived from the docks at 9 per cent., and he calculated that the railway would yield 8½, or 17½ per cent., altogether.

The Railway and Dock Company appears to have died a natural death, and the next document published, in the Volume of Selections from the Records of the Government of India under notice, is a Memoir accompanying a letter, dated 20th December 1883, addressed to the Marquis of Dalhousie, then Governor-General, by Mr. Charles Greaves, on the subject of Dock Accomodation in the Port of Calcutta. Mr. Greaves was an Engineer employed under the late Mr. Rendel in designing and superintending the vessels and machinery of a Company which was formed in 1840 and 1841 for the purpose of carrying out a ferry on the floating bridge system across the Hughli at Calcutta, but which failed "owing to circumstances entirely dependent on commercial affairs." This system of transit, by which the steam bridge or boat hauls itself backwards and forwards along chains which pass through its machinery, Mr. Simms said had been introduced to notice in the steam ferry over the Tamar at Torepoint, completed in 1834, and afterwards by the establishment of similar means of conveyance across the Itchen River in 1836, and across Portsmouth Harbor in 1849, and it had been proved, he said, to be the most certain, most regular, and most economical method of working ferries across tidal estuaries or broad rivers. A description of the system will be found in a paper read before the Institution of Civil Engineers in 1838, and published in their transactions. But, though such a ferry may be the most economical and convenient means of transit where only a small and slowly accumulating traffic has to be dealt with, how unsuitable and inadequate it would have been proved for the wants of Calcutta has been amply proved by the establishment and working of the pontoon bridge designed by Sir Bradford Leslie, and Mr. Greaves' proposal of 1853 to establish such a ferry between the Salt Gola Ghât at Howrah and Kasinath Baboo's Ghât, just below the Mint at Calcutta, in connection with the docks he proposed should be constructed at Howrah, need not further be considerd. An isometrical drawing of the steam ferry boat is given in the Blue Book. Mr. Greaves discussed at some length the question of whether docks should be provided for Calcutta on the Hughli or on the Mutlah and rejected the latter alternative, and as regarded the question of their position on the Hughli, he was of opinion that they ought to be in the immediate neighbourhood of Calcutta, in favorable proximity to the best part of the usual anchorage, and in close conjunction with the railway station, of which no plans had then been made public, and that attention should be paid to the best and most effective method of keeping the docks filled without creating impediment by deposit of silt from Hughli water. For all these reasons he proposed that the docks should be on the Howrah side, and that they should be on the low-level system, that is, that the level of water in the docks should correspond to that of the lower high waters of the year, and that the muddy waters at the season of the freshes should be excluded. There were to be two docks of 18 acres each, with a long pier or jetty dividing them, and opening by gates into an entrance basin of 10 acres, which communicated with the river by three sets of gates, making either a long or a short lock. The sills of all the gates were to be built at 19 feet below the lowest high water in the year. Mr. Greaves differed from the Committee of 1846, who proposed a high-level system, under which the river was to be pumped into the docks in an unfiltered condition, entailing very strong and expensive retaining walls, and the clearance of the deposited mud by scouring. By his system natural filtration would perform the work of steam engines, and retaining walls would no longer be required. It was "optional, therefore, to confine walling to the entrances and prominent angles, using open-framed jetties or a lighter description of wall for the dock sides, and permitting the excavated slopes to stand at their greatest safe-inclination wherever walled sides may not be called for as quays. Scouring would by this plan be totally avoided." The two outer gates of the entrance from the river to the basin were to be double, that is, having reverse gates which would allow of vessels being locked into the basin, either downwards from high water or upwards from low water. Mr. Greaves supplemented his plan by a large dock of 57 acres for country boats, with two entrances directly from the river. His estimate of the cost of the docks, with boundary wall, swing bridge, buildings for officers and establishment, cranes and moorings, elevated water reservoir, and railways on the premises, was £400,000, besides £100,000 for warehouses of great capacity, £40,000 for a floating bridge in duplicate, and £60,000 for graving docks. His estimate of revenue, from shipping and tonnage dues only, was Rs. 5,79,750; but taking only 5 lakhs per annum, and the annual disbursement at 1 lakh, he arrived at a net profit divisible of 4 lakhs or £40,000, which would give a clear profit of 10 per cent. on the cost of the wet docks. The consideration which Mr. Greaves' proposal met with does not appear in the Blue Book, and the next document published is—

Proposals for the Construction of Docks at Calcutta, made on behalf of the Eastern Bengal Railway Company, and Messrs. Brassey, Wythes and Co., and by Rear-Admiral W. H. Hall, and Mr. W. B. Lewis, dated 18th May 1864.

The plans of the proposed works are not given, but they are said to have consisted alternatively of (1) a dock of about 50 acres, and a river quay abreast of the town of about 1,400 yards in length, or (2) a dock of about 30 acres and river quays at the entrance to the dock, and alongside the town, amounting to 2,000 yards' run altogether. After consideration of four sites—Chitpore, the front of the Mint, Howrah, and Kidderpore, the latter was selected. The estimate for the works was £1,000,000; Messrs. Brassey, Wythes and Co. were ready to be the contractors, and arrangements had been made with capitalists to provide the money if Government would give an equitable concession. These proposals seem to have been rejected by Government; as also were those of the "Calcutta Dock and Wharves Company," represented by Mr. Prestage, for constructing docks also at Kidderpore, which involved the grant by Government of the necessary land, at a cost to the State of £250,000 or £300,000, and of a 5 per cent. guarantee on the outlay of the Company, estimated at one million, to be provided for by a general rate on all shipping entering the port of Calcutta. But it is not clear from the records published whether these two last mentioned proposals were not one and the same.

NOTE ON IRRIGATION IN THE MADRAS PRESIDENCY.

By A. Pierres deClosets, C.E., F.R.S. of Arts and Sciences, Mauritius.

Irrigation in the Madras Presidency is supplied by rivers and tanks, and also from wells provided with different kinds of elementary machinery to raise water.

The rivers could be considered as supply-channels carrying down rain waters, and the several anicuts constructed across these rivers have for object the diversion of the river waters into irrigation channels and into tanks where waters are stored.

From the rain waters a very small portion could be utilised, as one part is absorbed by the earth, another lost by evaporation. Of the remainder, the major part runs to the sea, and a small portion of it only is available for irrigation.

When the rain fails, there is a scarcity of crops, and famine follows as a natural result.

It is to be observed, that an immense surface of cultivable ground is left bare on account of its altitude above tanks or streams, which prevents the possibility of irrigation by channels; upon such lands, wells only could be resorted to for the water necessary to irrigation, but the number of these wells is not in proportion with the area to be irrigated; the water-supply from wells, at few exceptions, is inexhaustible, and could be relied upon everywhere, but well water cannot be raised without expenditure.

These considerations have induced me to investigate the mode of irrigation from wells, and to see whether it was not possible to introduce a sufficient power as cheap as possible, and always at hand, and apply the same for raising to the surface the water found below by the excavation of wells; this power is that of the wind which blows all the year round in the Presidency.

The following will refer to the means recommended for utilising wind-power for irrigation, after which I give some details as regards irrigation by artesian wells.

An established fact is that an immense volume of water exists underground, even in localities where gneiss is predominant. Into all the alluvial basins of the rivers on this coast, water is found everywhere at varying depths, generally from 3 to 15 and more feet; this superficial water is that which supplies the wells dug for irrigation.

In Madras the mean annual rainfall, calculated upon 22 years, has been found equal to 44 cubic inches, which represents a volume of water of about 100 millions of cubic feet per square mile; of this volume, one-third, or 33 millions per square mile, penetrates into the permeable soil, and is carried underground to the sea.

The water thus entering the ground, percolates the permeable strata, not in a single body, but into several layers of more or less thickness, and at more or less depth. I will therefore call well-water, the water-sheet or layer found uppermost and near the surface of the soil; and artesian waters, the water-sheets or layers found at greater depths underground, and which could be only obtained by boring holes of more or less diameter, and reaching the strata, into which waters are stored. As stated above, well water is generally found at 3 feet to 15 feet into the alluvial soils, and so as to utilise this water for irrigation, it is at the present time raised into the whole Presidency by animal power, by pecottahs, cavaleis or mots. These machines are so well known, that it is not necessary to make a description of them, but it would be found that from the whole of the means employed actually for raising water the pecottah is the cheapest of those acted on by men, but the cavalei or mot will be found still cheaper.

In Madras 4 men acting by relays of 2, working a pecottah will raise in a day's work of 12 hours, 30 poallears of water at 6 feet high; each poallear is of 100 buckets, the bucket is spherical, and contains 0·88 cubic foot; the daily work of 4 men is therefore 2,640 cubic feet, or 220 per hour. These men are paid generally in rice, and the amount per head could be estimated at 2 annas or 24 pies, or total per day, 96 pies. The cost of raising water with the pecottahs to a height of 6 feet will be then $\frac{96}{2640}$, or 0·036 pie.

With a cavalei or mot worked by two bullocks, the cost of water raised at above 10 or 12 feet will be per cubic foot 0·015 pie; with the double cavalei it will cost one-half of the cost of the single, or 0·007.

(To be continued.)

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

The recent very sad accidents on some of our Railroads here when the cars were upset and set on fire by the stove have caused our Railroad Managers and Inventors and the general press to put down these stoves and substitute steam. Various experiments and inventions are now being tried, but no good results thus far have been accomplished.

A description of one of these inventions—Case's Auxiliary Locomotive—may be of some interest. The invention consists of a steam boiler with furnace and the usual appurtenances, placed in the locomotive tender between the water tanks. The boiler rests on the floor of the tender and is covered with a hood of boiler iron which forms the floor of the coal bunker. This hood is curved over the boiler, between its sides and the water tanks, thus forming chutes for the gradual descent of the coal. A pitch is also given to the hood in the direction of the locomotive, in order to send the coal to a convenient place for the fireman to handle. The face of the boiler and furnace is toward the cap of the locomotive and is protected by a strong iron shield on both sides. The furnace door is placed above the tender floor and the fire-grate and ash-pit below. The smoke-box and smoke-stack are at the rear end, and the whole appears like a pony locomotive heading in the opposite direction from the locomotive proper. Any tender may be easily altered to admit the additional boiler. It is claimed for this plan of heating cars that it is the safest possible, as the tender being almost entirely of iron in case of accident the danger of communicating fire to the cars is reduced to a minimum; the water tanks of the tender if crushed, will liberate enough water to drown out the furnace fire. The fuel needed for feeding such a furnace will be at least one-third less than is now required to keep going the fires in the stoves of a long train.

The fire in the locomotive itself is a source of danger in case of collision or derailment from which there is no exemption. By this device that fire and the fire which generates heat for the cars are both at one extremity of the train and the danger spots in a train are reduced to a minimum. This device will add less than three tons to the weight of a train instead of twenty or thirty tons, which will be the case if a separate iron car is adopted. It will furnish a far more reliable source of heat than the locomotive and give the same result that a boiler in special car will, at less expense than either.

The result of the investigation of the Roslindale Bridge disaster on the Boston, and Providence Railroad near Boston, Mass., has just been made to the Legislature of Massachusetts by the Railroad Commissioners. They hold the Company responsible and report criminal neglect and mismanagement and say that the accident furnishes another proof of the necessity of abolishing the deadly car stove. The general conclusions reached are about as follows: The contract for rebuilding the bridge in 1876 was made without proper examination as to the standing of the contractor. Those who acted for the Corporation in making the contract had not sufficient knowledge of iron bridge building to enable them to pass intelligently upon the design and specifications. The design and specifications for the bridge were not such as should have been accepted. The bridge was constructed practically without superintendence on the part of the Corporation and the Corporation neglected to preserve a copy of the specifications, drawings and strain sheets. The tests of the bridge were not made in the presence of any one acting for the Corporation who was qualified to judge of their value. From the time of the construction of the bridge to the day when it fell the Railroad Company had caused it to be examined by one man only, who, year after year, passed over vital parts of the bridge without realizing that they were of importance. This man had been in the employment of the Corporation for a long series of years. His trade was that of a mechanist. He had

not been educated as a Civil Engineer and the management had abundant reason to know that he was not qualified and had no opportunity to qualify himself to do the work assigned to him with reference to this bridge. The series of tests of the bridge recommended by the Board of Railroad Commissioners in 1881 were not made. In the erection and inspection of bridges the management of a Railroad is bound to exercise the utmost care. Had such care been exercised there is every reason to believe that the disaster would have been prevented.

The Board renews the expression that "a preventible accident is a crime." Notwithstanding the repeated warnings of the Board, the spaces between the ties on this bridge were far too great for safety and no suitable guard rails or guard timbers were placed upon the bridge. The Westinghouse automatic air brakes, a safety appliance remarkable alike for its simplicity and effectiveness, and long ago approved and adopted by all leading railroads, was not in practical operation on this train, neither was the train furnished with a sufficient number of brakemen to comply with the requirements of the statutes.

The great problem of rapid transit in New York still puzzles the minds of engineers and legislators and capitalists.

The cable road in the upper part of the city works well and gives great satisfaction, and in the near future it is said the system will be extended over one of the great horse railroads in the city.

Considerable attention of late has been given to experimenting with electricity on one of the elevated branches. The motor used is what is known as the Daft Electric Motor. It has been in operation in the city of Baltimore, Md., for a number of years. The road there is built over heavy grades and around sharp curves and has been operated economically and advantageously.

One of the first steps taken by the Company to try their motor was on the Mount McGregor R. R., near Saratoga, New York.

Here the steam engine was rated at 25 horse-power, and an average current was supplied by two generators of 10 horse-power each, and conducted to the motor by an ordinary track rail laid between the two, upon blocks saturated with asphaltum and capped with vulcanized fibre. The load hauled was 18 tons, the grade 9 feet per mile, and the maximum speed 12 miles per hour.

A street car run by an ammonia engine in New Orleans, La., is reported to cost but $2·68 per day to run. The engines cost $700·00 each, and the central plant $15,000·00 for 30 cars. Power is obtained by the expansion of liquid ammonia into gas, which is done without fire.

The work on the great Cantilever Bridge across the Hudson River at Poughkeepsie, New York, is being rapidly pushed. The masonry and foundation of the piers and the superstructure of this bridge are in progress towards completion.

NOTES FROM HOME.

(From our own Correspondent.)

The projectors of the City and Southwark subway anticipate a very much more comfortable state of things in their tunnel by the absence of steam locomotives and in the use of the cable systems they promise their ability to obtain a rate of speed equal to that on the underground Railway. This will be the first trial of the system as an underground line.

A new explosive for mining use invented by Mr. Fairer has been tried within the last few days at the Quenast granite quarries in Belgium. The results are said to prove this compound to be the most powerful yet known. It is interesting and suggestive to read in connection with this subject the reports for the year 1886 of the explosive companies already in existence and to note their fat and still fatter growing dividends. The Nobel Company at Glasgow declared a dividend at 15 per cent. Thus the old explosives hold their ground against the modern ones, and the general success of these companies indicates an increased activity in the mining industries.

The new Tay bridge is practically completed, and it will be opened for traffic in the beginning of June. It is 8 years and 4 months since the former bridge was blown down. The length of the new bridge is close upon two miles. The widest spans are 230ft. and the highest part of the bridge gives a clear headway of 77ft. above high water level. The girders rest on 73 pairs of piers, which are built of brick faced with vitrified Staffordshire brick, courses of granite and wrought-iron. The site of the new bridge is about 20 yards west of the ruined structure.

Engineer has given a series of engravings affording a good idea of the character and appearance of the bridge when complete, and also shewing the process of raising the girders to the top of the piers. Reference is made to the detailed accounts and drawings of the bridge, which have appeared in the previous issues of this paper.

As was expected, the Elswick exhibits form a marked feature of the Newcastle Exhibition, which was opened last week by the Duke of Cambridge. Sir William Armstrong's firm here places before the public some very interesting developments of artillery, rapid firing guns, machine guns, guns with carriages to disappear, and the many modern appliances tried and untried in this branch of engineering, form an important addition to this year's great Exhibition of the North.

The Lifeboat Institution offer a gold medal and a silver medal for drawings or models of a mechanically propelled lifeboat, also a gold medal and a silver medal for models or drawings of a propelling power suitable for the boats of the Institution. Drawings and models must be sent to the Institution not later than the 1st of October next.

A new patent fuel has recently been experimented upon at the Bosley Collieries, near Sheffield, in the shape of briquettes, which are retailed at one penny and one half-penny. These briquettes are made of coaldust and pitch. These materials form a hard black block, which will not burn as brightly as the ordinary coal, but sends off as much heat and lasts longer. If successful, it will get rid of what is now a drug in the market.

The manufacture of paper bottles invented in Chicago is said to become a considerable industry. These bottles are unbreakable and are of various sizes and forms to suit the various requirements of the trade. They are made by special machinery, and in their manufacture a large sheet of paper glued and cemented on one side is rolled on a mandul into a tube of any required length, thickness and diameter. The interior of the bottles is lined with a fluid composition which sets hard and resists acids and spirits. Irrespective of low cost, they have the advantage of being unbreakable, requiring no packing and are lighter and therefore economical as to freight.

The paper barrels in which flour was recently shipped to New York resemble the common wooden barrels thickly varnished. They are made in 5 pieces bound with ordinary wooden hoops, and the cost when unpainted is nominal. The interior and exterior are glazed with a substance which renders the barrel impervious to moisture.

Under the direction of Sir F. Bramwell nearly £150,000 has been expended by the Corporation of Portsmouth on the improvements in the drainage of the Borough, and the works which mark a new era in the science of sewerage were formally inaugurated a few days ago by the Mayor in the presence of a representative company comprising several scientific authorities of national repute.

The following gentlemen, having satisfied the examiners at the examination recently held in London by the Association of Municipal Engineers, the Council have granted them certificates of competency: Messrs. E. W. Rich (Hounslow), B. Verschoyle (Liverpool) F. J. Nickols (Leeds), Charles Adcock (Liverpool), E. J. Nichols (Leeds), Henry Dearden (Leeds), F. E. Cooper (Liverpool), J. Saunders (Newark), and T. W. Franlis (West Bromwich).

The gigantic undertaking, the Vyrwnery Waterworks, is making good progress. Up to the end of March over a million and a half had been expended on them.

The paper last week at the Institution of Civil Engineers was upon the conversion of timber in the pine growing districts of America by circular saws and band saws in which the respective merits of the two systems were considered, as to quality of work and economy. In summing up the author says that for the converson of pine logs the balance of advantage lies distinctly with the band saw; and if this is so in the case of comparatively small and cheap timber, it is certain that for the more valuable descriptions of hard woods which frequently run to very large sizes these advantages would be enormously increased.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Central Provinces, June 11, 1887.

Mr. H. Humfress, Assistant Engineer, 2nd grade, is transferred from the Kanhan Division, to the Chief Engineer's Office, Central Provinces, on special duty in connection with a Reconnaissance Survey.

Punjab, June 9, 1887.

Lala Sagar Mal, Assistant Engineer, 1st grade, from the Dera Ghazi Khan Division, to the Irrigation Branch, Punjab.

Irrigation Branch

Rai Rajjan Lal Sahib, Assistant Engineer, 1st grade, from the Lower Sutlej and Chenab Division, Inundation Canals, which he left on the afternoon of the 7th May 1887, to the Dera Ghazi Khan Division, Indus Canals, which he joined on the afternoon of the 10th May 1887. The transfer was made in the interests of the public service.

Mr. J. K. E. Verschoyle, Assistant Engineer, 1st grade, is temporarily transferred from the Swat River Canal Division, which he left on the afternoon of the 7th May 1887, to the Chenab Canal Division, which he joined on the afternoon of the 8th May 1887. The transfer was made in the interests of the public service.

Mr. F. W. Chanter, Executive Engineer, 4th grade, from the Karnal Division, Western Jumna Canal, to the Office of Superintendent of Works, Western Jumna Canal, to which he has been attached on special duty, with effect from the 15th May 1887.

Burma, June 4, 1887.

Upper Burma Notifications.

With reference to Upper Burma Public Works Department Notification dated the 17th May 1887, the following officers have been posted to the divisions concerned :—

I.—The *Meiktila Division*—

Mr J. C. Rees, Executive Engineer, 3rd grade, in charge.
Rai Bahadur Bhagat Singh, Executive Engineer, 3rd grade, sub. *pro tem.*
Mr. B. H. Blacker, Assistant Engineer, 1st grade.
Mr H. W. James, Assistant Engineer, 1st grade.

II.—The *Taungdwingyi Division*—

Mr. P. B. Roberts, Executive Engineer, 2nd grade, in charge.

III.—The *Minbu Division*—

Mr. P. Sharp, Executive Engineer, 3rd grade, sub. *pro tem.*, in charge
Mr. W. W. Robertson, Honorary Assistant Engineer.

IV.—The *Myingyan Division*—

Mr. W. B. Campbell, Executive Engineer, 4th grade, temporary, in charge.
Mr. J. Leonard, Assistant Engineer, 2nd grade.

V.—The *Mandalay Civil Division*—

Mr. E. J. Rumsby, Executive Engineer, 3rd grade, in charge.
Mr. J. Donnan, Assistant Engineer, 1st grade.
Mr. A. D. Anthony, Assistant Engineer, 3rd grade.

VI.—The *Chindwin Division*—

Mr. J. P. Henderson, Executive Engineer, 4th grade, temporary, in charge.
Mr. C. E. Housden, Executive Engineer, 4th grade, temporary.

VII.—The *Shwebo Division*—

Mr W H. King, Executive Engineer, 2nd grade, in charge.
Lieutenant C. N. Beevor, R.E., Assistant Engineer, 2nd grade.
Mr. T. Concannon, Executive Engineer, 4th grade, temporary.

VIII.—The *Bhamo Division*—

Mr. J. Wallace, Executive Engineer, 4th grade, sub. *pro tem.*, in charge.

IX.—The *Ruby Mines Division*—

Mr. R. D. Buck, Assistant Engineer, 1st grade.
Mr. W. E. Muntz, Assistant Engineer, 2nd grade.

Lower Burma Notifications.

The following Sub-Engineers are promoted to the rank of Honorary Assistant Engineers :—

Mr. J. G. McKertich, Sub-Engineer, 1st grade.
Babu Ram Dass Bhatacharji, Sub-Engineer, 3rd grade.

Mr. F. R. Bagley, Executive Engineer, 3rd grade, is appointed to the charge of the 5th division of the Toungoo-Mandalay Railway Extension, extending from mile 115, chain 3,320, to the south bank of the Samon river in mile 164, with head-quarters at Pyawbwe. This appointment to date from the 1st June 1887, from which date the "C" Survey division will cease to exist.

Burmah State Railway.

With reference to this office Notification dated the 23rd instant, Mr H. Groves, Executive Engineer, 2nd grade, is temporarily attached to the Engineer-in-Chief's office, with effect from the 23rd May 1887

Mr. E. J. Alexander, Assistant Engineer, 1st grade, reported his arrival at Rangoon on the forenoon of the 30th May 1887 and is posted to the 7th division, Toungoo-Mandalay Extension.

N.-W. P. and Oudh, June 11, 1887.

Buildings and Roads Branch.

Mr. G. J. Joseph, Executive Engineer, 3rd grade, is posted to the charge of the Allahabad Division, Provincial Works, during the absence of Mr. Hodges, Executive Engineer, on leave, or until further orders.

Irrigation Branch.

His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following promotion, with effect from the date specified:—

Mr. H. J. Strickland, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary, *vice* Mr. Nicolls on furlough, 6th May 1887.

In supersession of Notification dated 28th April 1887, His Honor the Lieutenant-Governor, North-Western Provinces, and Chief Commissioner, Oudh, is pleased to order the following promotion with effect from the date specified:—

Mr. W. B. Gordon, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary, *vice* Baboo Jogindro Nath Mukerji, on furlough 15th March 1887.

Bombay, June 9, 1887.

H. E. the Right Hon. the Governor in Council is pleased to make the following appointments, *vice* Mr. J. H. E. Hart, who has been granted privilege leave, from 10th June 1887, or such later date as he may avail himself of it.

Mr. J. E. Whiting, M.A., M. Inst. C.E., to act as Chief Engineer, for Irrigation and Superintending Engineer, Central Division.

Mr. A. Hill to act as Executive Engineer, Nira Canal.

The duties of Joint Secretary to Government, Public Works Department, Irrigation, will be performed by the Secretary to Government, Public Works Department, during Mr. Hart's absence.

Mr. H. J. Landon, Assistant Engineer, first grade, acted as Executive Engineer for Irrigation, Khandesh, from 6th April to 25th May 1887.

Assam, June 4, 1887.

Privilege leave for three months is granted to Mr. E. J. Mitchell, Assistant Engineer, 2nd grade, with effect from 18th June 1887, or such subsequent date as he may be permitted to avail himself of the same.

India, June 11, 1887.

The following officers are transferred temporarily to Burma Provincial Establishment, *viz.*:—

From Bengal.—Mr. J. T. Simpson, Executive Engineer, 2nd grade; Mr W. P. Milne, Executive Engineer, 4th grade, sub. *pro tem.*, Mr. J. A. Price, Executive Engineer, 3rd grade.

From North-Western Provinces and Oudh.—Mr. A. T. Dodsworth, Executive Engineer, 4th grade, sub. *pro tem.*

Assam, June 11 1887.

Privilege leave for three months is granted to Rai Sahib Brij Mohanlal, B.A., Assistant-Engineer, 1st grade, with effect from such date as he may be allowed to avail himself of the same.

The one month's privilege leave sanctioned to Mr. G. W. Winckler, Executive Engineer, in notification dated the 20th May 1887, is hereby extended four days. Mr. Winckler availed himself of the thity-four days' privilage leave on the forenoon of the 6th June 1887, making over charge of the Public Works, Kamrup, to the Deputy-Commissioner.

Privilege leave for two months and twenty-five days is granted to Rai Bholanath Dass, Bahadur, Executive Engineer, 1st grade, with effect from such date as he may avail himself of the same.

Mr. D. J. Clancey, Assistant Engineer, 2nd grade, is, in the interests of the public service, transferred from the Khasi and Jaintia Hills Division to the Cachar district, and appointed to officiate as District Engineer of Cachar, *vice* Rai Bholanath Dass, Bahadur, proceeding on privilege leave.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

The 23rd May 1887.

178 of '86.—Patrick Daley, Engine-man of Rajputana-Malwa State Railway, residing at Saburmattee near Ahmedabad in Guzerat. *For a through communication between Brake-van and Engine.*

213 of '86.—Marcus Begg, Tea Planter of Noahabarie, Jorehaut, Upper Assam.—*For an improved Tea Rolling Machine.*

81 of '87.—The Westinghouse Brake Company, Limited, of Canal Road, Kings Cross, in the County of Middlesex, England.—*For improvements in fluid pressure automatic brake mechanism.*

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OWING to the great and unexpected demand for our early numbers, we regret that we will not be able to supply back copies and subscriptions can, therefore, only be registered from the date of receipt of order.

CONTENTS.

Obituary.

BAYLY.—On 12th June, at Madras, G. H. Bayly, M.I.C.E., Executive Engineer, Mysore, P.W.D., aged 41 years.

INDIAN ENGINEERING.

SATURDAY, JUNE 25, 1887.

VOL. I.—JANUARY—JUNE, 1887.

THE first half-year's publication of INDIAN ENGINEERING is completed with the present issue. The Index is under preparation and will be supplied with the Title-page for binding at an early date.

NAVAL DOCKYARDS IN THE EAST.

THE Government of India is a Government of anomalies. All around us we see the sorry spectacle of an elaborate administration with some important section of the machinery either disabled or altogether omitted. How its smooth working can be assured, notwithstanding those drawbacks is a mystery to those uninitiated in the secrects of a bureaucracy. At times the deficiencies are painfully brought home to us in some national disaster, and we close the stable-door after the steed has been stolen. A state of unpreparedness seems to be the rule, and our readiness to act in an emergency the exception. Would it not be wiser, and in accordance with the dictates of prudence that we set our house in order before a calamity overtakes us, when it might, perhaps, be somewhat late in the day to rectify the omission. The policy of *laissez faire* is scrupulously adhered to, when a little activity might help to avert the danger. Always be ready with your pistol is a truism which does not seem to find a place in the sober deliberations of our rulers. While other nations profit by the teachings of past experience, we permit history to repeat itself when our affairs are concerned.

Take for example the defences of India. Such a state of things is without a parallel in the history of the world. A country governed by an alien race, and which is supposed to be eagerly coveted by another European power, not far from our North-Western limits, has a sea-board of thousands of miles; and not a single port throughout its entire length that could stand a siege for twenty-four hours. Of course, something has been done in that direction to secure the safety of the river approaches to the Metropolis, where perhaps it was least required. No foreign fleet would ever dream of coming up the river, unless its commander had made up his mind to meet the certainty of a watery grave among the treacherous sands of the Hughli. It is true the pockets of the poor rate-payers have been squeezed dry to construct a 'scientific' frontier, which might never be of any service whatever. But beyond these, what has been done to enable the country to repel foreign invasion? Simply *nil.* Look at Bombay and Madras. The latter could be bombarded and laid in ruins before any damage could be done to the attacking fleet. As for the former, it is a fact that there are two floating batteries in the harbor, but as to what protection they could afford in the hour of danger we leave experts to speak for themselves.

This, however, is not all. Even in the matter of

docks the country is as badly off; and we go to sleep in blessed ignorance of danger, until some inquisitive Member of the House of Commons throws some light on the subject, and draws out the Secretary of State for India; it then becomes a nine days' wonder, to be soon crowded out of memory by other facts. In reply to a query from Admiral Field, Sir John Gorst is reported to have said that the original cost of the iron floating dock at Bombay was £307,000. The expenditure was incurred in 1868 by authority of the Secretary of State for India in Council, and by the advice of the Government of Bombay backed by the Government of India. He was not aware of any ships of Her Majesty's Navy having been docked there. This dock had been leased to the Peninsular and Oriental Company for five years at a nominal rent, the Company being under the obligation to keep it in proper repair. Referring to the subject we wrote some time back that the result of the consideration given by the Board of Admiralty to Sir John Coode's reports has been to determine it to begin at a very early date with the construction of a dock at Bombay, suited to the reception of the largest of our iron clads. It is considered that further accommodation should be also provided for H. M.'s ships in Eastern waters, either at Trincomalie, Colombo, or Singapore. Now considering that there are at present two dockyards, one at Malta and the other at Hong-Kong, there should certainly be an intermediate one, and Bombay offers great facilities for such a structure of the necessary capacity.

There is one point, however, to which we would invite the attention of our readers. Referring to Sir John Gorst's reply quoted above, it would appear that a hydraulic dock had been erected for the reception of vessels; but at the first trial made of its capacity, it came to grief. According to published accounts, the site of it had been so injudiciously selected that currents, we presume comparatively strong only, absolutely prevented safe entry between the columns and over the pontoon upon which the vessel making the first essay was to be raised. It was found impossible so to direct the course of the ship as to prevent her fouling the columns; and several of these were carried away, or at least so deranged that they were rendered incapable of fulfilling their legitimate function. We must conclude, as we cannot learn that any attempt was ever made to repair the dock, that this first instance of failure had convinced those in charge of it that the difficulty experienced as to safe entry at this first trial must for ever remain insuperable. Now, as is well understood, too great care cannot be employed on such constructions, for if it is a walled dock, less anxiety may be felt in ships entering it, as in that case the danger is confined only to the ship, if it is not properly handled; whereas in the case of a hydraulic lift, the vital parts of the structure receive injury, and it is, therefore, of the utmost moment that the undertaking should enjoy immunity from any unnecessary risks. Ignorance of the state of the harbor cannot be pleaded as an excuse, for it has been surveyed and resurveyed so often that there are scarcely any of its salient features that have not been properly ascertained and recorded. As the *Times of India* very properly observes "The present dockyard is not only exposed to hostile fire from the entrance to the harbor, but could also be worried by occasional shells from any ship carrying heavy breech-loaders, and cruising off Malabar Point We do not intend to enter here on the relative merits of the Hog Island site, or any other; but to emphatically insist on the absolute necessity of the site selected being safe from any possibility of bombardment. As a harbor of refuge for a ship disabled in action, the dockyard must be able to offer perfect safety during the execution of any necessary repairs, for the vessels in dock are perfectly helpless to defend themselves, and would suffer abnormally and uselessly from attack in that position, while it would be extremely difficult, if not impossible, to persuade native workmen to work in any place where a shell had fallen."

SINGARENI COALFIELD.

NOT long ago we furnished some particulars relative to this field which, it would appear from English papers, has been since favorably reported upon by Mr. T. W. H. Hughes, of the Geological Survey of India. To Dr. King is the honor due for drawing the earliest attention to the importance of the field which, according to the most recent account received, promises to take a commanding position in the material development of a heretofore but little known part of the country. The investigations of Mr. Hughes have resulted in the discovery of a productive area of six square miles. Assuming the average thickness of coal at 26 feet we have, as already mentioned in our last issue, a total of 156,000,000 tons, of which 94,000,000 tons will be available for the market. The coal is declared to be *excellent* and capable of bearing exposure and handling. The clay lamination so conspicuously present in the Raniganj coal is altogether absent in this coal. There is another variety suitable for smithy purposes and showing tendency to coke. Mr. Hughes believes sufficiently good coke could be manufactured to meet local requirements or furnish a supply in connection with smelting works. Nature could not have been more bountiful in the localisation of this field, which is surrounded by extensive deposits of limestone and iron ore of excellent quality, thus pointing to future industrial possibilities. Happily this is not the only spot so favored in the country. There are the Raniganj, the Beerbboom, the Palamow, and other mineral areas, which for want of capital and easy and inexpensive means of communication are, with one exception, abandoned or crushed out of active existence by the overpowering current of foreign competition. The resources of the country are vast and unlimited and are availably located, but it is the want of a fixed policy on the part of Government and the want of capital, the soul of business, that delays their development. We are inclined to characterise the policy of England towards India as selfish and oppressive in some respects. The belief that she is growing rich while India is becoming poor—obtains benefits at the expense of her poor Indian subjects—has apparently some foundation.

The Government imports into the country yearly stores, materials of war, railway plant, &c, amounting to upwards of 2½ millions sterling, and what a drain this is on the exchequer of the country? But how can we expect an improvement when this continues from year to year without an attempt to so arrange things as to counterbalance the account?

We do not wish it to be understood that the policy of England has hitherto been *unwise*, but only imply that it has been somewhat selfish. What we would wish to see is,—and it is not inconsistent with the present condition of the country and its institutions, its claims and aspirations,—that the country be converted into a vast field of manufacturing and industrial centres and supply her own requirements from her own resources. This cannot be accomplished without English capital, which must be invited into the country by a wise and accommodating policy. With a dozen companies like the "Hydrabad (Deccan) Company," enjoying like privileges and concessions, the country would soon present a prosperous appearance. It is needless to look to the *plough* alone for the enrichment of the country, the furnace, the hammer, and the chisel must also be recognised as elevating and wealth-producing factors. With raw materials absolutely without limit, with abundance of cheap and industrious labor, and a vast country to serve, English capitalists would find India a congenial field for investment.

FINANCE AND REVENUE ACCOUNTS FOR 1885-86.

A RECENT number of the *Gazette of India* contains a Government Resolution on the Finance and Revenue Accounts for 1885-86, which is interesting from more than one technical point of view. The only disturbing element was the fluctuation in the Exchange on English expenditure, which was considerably worse than the Estimate. The Budget Estimate was framed on the basis of an Exchange of 19*d*. or £1=Rs. 12-6as. the rate actually realized and at which the English net expenditure was brought to account was 18·2*d* or £1=Rs. 13-1a. The explanation given of the Provincial adjustment being worse than the Budget by £1,248,100 is, that shortly after the beginning of the official year there arose the necessity of making large military preparations in the North-Western Frontier, and the Supreme Government issued orders to Provincial Governments to curtail, as far as possible, all expenditure of an optional character. This entailed a curtailment of expenditure, chiefly in the P. W. D., and between this reduction and the Provincial share of the improvement of Revenue, over the Budget, they underspent their revenues by £523,900, and appropriated £724,200 of past accumulations. Attention is drawn to the fact that under Railway receipts (£1,184,400) the Imperial Revenue improved; to the saving in Provincial expenditure, that on Buildings and Roads (£466,300) mainly contributed.

In regard to the charge for interest on debt, £78,600 was debited to the portion charged to Railways and Irrigation Works.

With reference to Railways the year under review shows general improvement, being a more favorable one than was anticipated at the time of the Estimates. The depression caused by the falling off in the wheat trade in 1884-85, was in a measure recovered. The net earnings under the heading 'Irrigation' (Major Works) sh ew that the Estimates were not realized, the receipts being less than in any of the preceding five years. The Estimates were framed for a considerable falling off even from the former standard, owing to the failure of the Nadrai aqueduct, which greatly diminished the water supply to the Ganges and Lower Ganges Canals. There was another cause of the diminution in receipts, *viz*., from the Western Jumna Canal; this is accounted for by an abundant rain-supply during the year. Particular stress is laid in the Resolution on the results for 1884-85, which was one of exceptionally high revenues, and the same favorable returns may not be repeated.

On the subject of Buildings and Roads, there was an augmentation in the receipts by exceptional revenues; in the expenditure on Military Works the annual grant of one crore was slightly underspent. Regarding the expenditure in Civil Works the difference between the Budget Estimate £4,136,500 and the Revised Estimate £3,706,200 is attributed to the restrictions necessitated in the early part of the year.

Under Capital Expenditure are included 'Railways' and 'Irrigation.' As to the first the excess over the Budget Estimates was due to the rapidity with which the construction of the Railways on the North-Western Frontier was carried on. As to the second item, the Budget was reduced to secure funds for Railway construction.

IMPORTANT ANTIQUARIAN DISCOVERY.

AN antiquarian discovery of some importance has just been made by the Collector of Kistna, Mr. R. Sewell. The 'find' consists of a series of rock-cut sculptured caves in the side of a hill forming the western boundary of a small valley situated about 20 miles north of Ellore in the Godaveri District. The principal caves are (1) a Buddhist *Chaitya*, consisting of a single circular chamber, containing a *dagoba* seven feet high; (2) a *Vihara*, formed of a row of sculptured rooms and cells, which constituted the residence of the monks. The *Chaitya* has some resemblance to the well-known *Lomas Rishi* cave in Behar, and differs from it only in having no pillared vestibule to the principal *dagoba* chamber. A few letters of an inscription on the *Vihara* help to fix the date at about 100 or 150 A.D. There are several other large excavations in the same hill-side partially sculptured, while on the hill above are the remains of a large brick *stupa*, and in one place a number of pillars, many of which were found lying on the ground, but three or four standing. They are much weather worn, and are sculptured in an early style. The great interest in this discovery, however, lies in the fact that the monument belongs to a class of which no examples have as yet been discovered in the South of India. The attention of Dr. Burgess, of the Archæological Survey, has been called to the 'find,' so that we may expect to hear more about it later on.

Notes and Comments.

MADRAS HARBOR.—There is an *erratum* in Art. XIII. which we wish to correct. At beginning of 2nd column, p. 364—300 feet should be 500. The only question has ever been between 550′ the original width, and 450′ the width to which the Home Committee recommended the mouth should be reduced.

BOMBAY PORT TRUST.—Prince's Dock Extension Works Progress Report for May (1887) shews that the total amount paid to the contractors was Rs. 35,38,827. The daily average number of men and women working on the Dock and at the quarries was 4,411, the greatest number in one day (7th) being 4,839.

TRICHINOPOLY SANITARY IMPROVEMENTS.—The largest town in Southern India stands in urgent need of good drinking water and imroved drainage. The water-supply scheme now under investigation will probably cost not less than a lakh of rupees, while the drainage scheme prepared by Major Brockman in 1880, and still awaiting execution, amounts to nearly three lakhs.

GOLD-MINING PROSPECTS IN MYSORE.—Mr. Lavelle's Report, which we are publishing, on the gold-bearing tracts of Mysore, have been checked by Mr. Bruce Foote, of the Geological Survey of India, who was deputed by the Government of India for the purpose. The matter is now under consideration and in due course final orders will be issued as to the terms of mining concessions to be granted in future by the Mysore Government.

THE ARMSTRONG ENGINEERING SCHOLARSHIP.—This Educational endowment is a tribute to the Civil Engineer who controlled the P. W. D. of the Central Provinces for several years. The Scholarship is open to any native of the Central Provinces who either desires to go to Roorkee to qualify for a Sub-Overseership at the Thomason College or who wishes to proceed to the College of Science, Poona, to qualify for the same position.

ENGLISH ENGINEERS FOR JAPAN.—The Kobe-Shimonoseki Railway Company has decided to engage a Superintending Engineer from England. Mr. C. A. Pownall, M.I.C.E., of the Kobe Government Railways, now in Europe, has been asked to secure a suitable person. We also learn that the Tôkyô Gas Works are to have an English Engineer after all. These are the appointments which were supposed to have fallen to Germany owing to diplomatic influence.

AMERICAN LOCOMOTIVES FOR CHINA.—The grand Locomotive Works, of Paterson, recently shipped through Messrs. Russel & Co., of China, the first locomotive engine ever built in America for use in China. It goes to the Kaiping Railway Company, Limited, which controls the Kaiping Coal Mines, about seventy-five miles north-east of Tien-tsin, in the province of Chili, and has a light railroad of standard gauge, twenty-eight miles long, and used for hauling coal.

AN IMPORTANT APPOINTMENT.—The appointment of Director-General of Mines, referred to in article 12, clauses XI. and XV. of the Mining Agreement, was made by His Highness the Nizam, on the 19th Rajjab, H. 1304, corresponding with 5th April 1887, and Mr. Syed Ali Bilgrami, B.A., F.G.S., A.R.S.M., a covenanted servant of the Hyderabad Government, who received a technical education in England at the expense of Government, nominated to the appointment.

MILITARY OPERATIONS IN BURMA: THE TELEGRAPH DEPARTMENT.—The thanks of the Commander-in-Chief are given to the members of the Telegraph Department under Mr. C. P. Landon, through whose exertions many miles of telegraph have been established and kept open for work under great difficulties; and His Excellency fully endorses the praise accorded by Sir George White to the officers named by him. This acknowledgment is specially endorsed by the Governor-General in Council.

THE PUBLIC SERVICE COMMISSION.—Colonel Mallock, Deputy Director-General of the Telegraph Department, gave strong evidence in favor of recruiting for the superior grades from England. They must have the best men obtainable to keep up the efficiency of the department, as the Superior officers were also frequently required for field service. Even recruiting from Cooper's Hill they did not at present get the best men, because the training was one year less, and the pay was less than for the Public Works Department.

THE LATE MR. G. H. BAYLY, M.I.C.E.—We deeply regret to have to announce the untimely death of Mr. G. H. Bayly, the Executive Engineer of Mysore. Mr. Bayly was a servant of the Imperial Government, whose services for several years past were lent to the Mysore State. "Capable in every way, conscientious in everything, hard-working always, he was eminent both in public and in private. No man ever had greater confidence reposed in him, and no man, we suppose, was ever more respected and esteemed by those who knew him." Mr. Bayly was a B.A., L.C.E., Trinity College, Dublin.

SHONE HYDRO-PNEUMATIC SYSTEM OF SEWERAGE.—This system is in extensive operation in England and abroad, and has recently been applied to the Houses of Parliament, London. The Engineer himself has furnished us with his Report for publication. The system is especially suitable for flat territories, as by the adoption of this principle good gradients can always be obtained. It can also play a successful part in ameliorating and supplementing existing sewerage arrangements without, in the majority of cases, necessitating the reconstruction of the works. It is likely to soon get an extensive trial in America.

IRRIGATION WORKS IN THE N.-W. P.—The most important fact in connection with the irrigation in the North-West and Oudh last year was the complete destruction of the Nadrai Aqueduct, which carried the Lower Ganges Canal over the Kali Nadi. This was caused by an unprecedented flood in the Nadi due to three successive days of heavy rain in the Bulandshahr, Aligarh, and Etah districts. Fortunately the accident did not put such a complete stop to irrigation as might have been expected, for the country irrigated by the Lower Ganges Canal has since been satisfactorily served from the Upper Canal, except in the case of the Bewar branch, which had to be closed.

THE SINGAPORE, STRAITS SETTLEMENTS AND SIAM ELECTRICAL COMPANY, LIMITED.—The object of this new company, which has been formed under respectable auspices, is to acquire and work an electric lighting concession, dated September 1885, for Singapore and the Straits Settlements, and for carrying out electrical work in all its branches, including telephones and telegraphs. A glance at the prospectus, which is replete with information, shows the importance and rising positions of some of the localities and towns where the company intends to transact business. It is, we think, very justly contended by the Directors that there is ample margin for large profits in introducing the electric light in these places, as gas costs three or four times what it does in England.

Field Operations in Burma: The Royal Engineers.—The number of Royal Engineer officers who have been employed in Upper Burma has been exceptionally large. The Commanding Royal Engineer, Captain A. R. F. Dorward, R.E., brings forward the names of the following, who have done special good service:—Captain W. F. Shone, Lieutenant I. A. Tanner, Captain (Brevet-Major) C. B. Wilkieson, Captain H. H. Barnet, Captain J. D. Fullerton, Captain M. C. Barton, Lieutenant T. F. B. Renny-Tailyour, and Lieutenant F. Glanville. His Excellency the Commander-in-Chief specially recommends Captain Shone, Captain Goodwyn, and Lieutenant Tanner. The Governor-General in Council thanks the Commanding Royal Engineer, Captain A. R. F. Dorward, D. S. O.

The Indian Railways.—We have been favored with the Director-General's Report for 1886. The net receipts of Indian railways for 1886 shew an increase of Rs. 63,14,996, giving a return equal to 5·90 per cent. on the capital, excluding indirect charges. Last year's percentage was 5·84. There was a general increase of receipts, but specially on the Great Indian Peninsula and the Rajputana-Malwa lines. The total tonnage of merchandise carried increased by 941,856 tons. The number of passengers carried increased from 80 to 88 millions. Of these the first-class passengers constituted only ·044 per cent. On the 31st of March, 13,390¼ miles of railway were open for traffic; 1,025½ miles were opened during the year. The total capital expenditure up to the 31st December amounted to 178 millions sterling. We purpose dealing with the Report more fully in an early issue.

Sind-Pishin Railway Honours.—The *Pioneer* complains that, although the constructors of the Ferozepore Bridge have already received their meed of praise, the authors of that much greater work, the Pishin Railway, have not yet been noticed. The *Civil and Military Gazette* thereon observes that it is well, perhaps, that members of Parliament at home are beginning to display a little pardonable curiosity about the construction, expense and other matters of the Line. The history of this costly blunder has not yet been written; but we have an idea that it will be some day. Meanwhile those who know most about it are naturally those who are inclined to say least. Nevertheless, a Resolution will shortly be published, thanking the officers of the Sind-Pishin Railway, and granting them either a gratuity of one month's pay for each year's service, or one month's leave for each year, which may be tacked on to any leave that may be due to the officers.

Field Operations in Burma: The P. W. D.—The Governor-General in Council acknowledges that the labors of the Public Works Department have been of marked value during this campaign. In this department the names of Mr. H. J. Richard and Mr. E. J. Rumsby have been specially brought to notice. Captain Dorward, R.E., brought to the notice of the Commander-in-Chief the very great assistance rendered to the officers of the Royal Engineers in their work by Messrs. H. J. Richard and E. J. Rumsby of the Public Works Department, and requested that some mark of the Viceroy's appreciation of their work may be accorded to them. Sir George White says that Mr. Edward Mitchell, Assistant Engineer, Department of Public Works, Assam, acted as Field Engineer in directing the road-making operations across the Sweja route from Tummoo to the Chindwin, and has been engaged since September in surveying for a military road from Manipur to Tummoo.

South India Ship Canal, Port and Coal Station, Limited.—On the 29th March this Company was registered, with a capital of £1,060,000, divided into 200,000 7 per cent. preference shares of £5 each, and 60,000 deferred shares of £1 each, to construct, work and administer a ship canal across the Island of Ramisaram, in the Indian Ocean, with a coaling station and harbor accommodation in connection therewith; and to construct other public works in Southern India. For such purposes the Company will adopt an agreement of the 11th February, between Burton Grindrod, Elliott Bradbridge, and Hy. Jenkins, of the first part, Francois Deloncle of the second part, and Isidore Spielman (for the Company) of the third part, for the purchase of a concession granted by the Secretary of State for India in Council, for making such canal. The number of directors is not to be less than five, nor more than nine; qualification, £250 of nominal capital. The remuneration of the board will be determined by the Company in general meeting, provided that £4,000 per annum be the minimum.

Public Works in the Pudukota State.—The allotment on public works during the year 1885-86 was Rs. 1,21,950, which, including an unexpended balance of Rs. 15,827 brought forward from the previous year, amounted to Rs. 1,37,777, and Rs. 4,074 were refunded, leaving a balance of Rs. 23,936 to be utilized in the following year. The two main roads from Pudukota to Trichinopoly and Tanjore were maintained and kept in perfect order. The road to Madura was completed and opened for traffic during the year. Some of the irrigation works were put in order. The reconstruction of the bridges that were washed away by the floods of December 1884 was nearly completed during the year under report. The principal roads in the capital were fully re-metalled and tunnelled wherever necessary. In addition to the tanks and ponds that were cleared and put in thorough order last year, eight more ponds in the capital were repaired during the year under review, but nothing is said of their supply channels, which require considerable attention. Mr. C. H. Wilks, M.I.C.E., has been appointed State Engineer from the beginning of the current official year.

The Director-General of Stores, India Office.—The waste entailed by having recourse to England in the manner done for Indian requirements, is evidenced by the fact that in contracts for iron-work for the Indian State railways, and other Government work, it is always stipulated at Home that there shall be "an addition of 50 per cent. to the net quantity of rivets, and of 10 per cent. to net quantity of bolts required for waste." Hence somebody wants to know what becomes of all these rivets and bolts, for surely it cannot be that the Government workmen spoil half as many rivets as they use, and one out of every ten bolts? Again we cannot see the wisdom of calling for the supply and delivery in England of iron-work for Roofing for Works and Running Sheds of the Indian State Railways when the drawings unmistakeably shew that they are *fac similes* of structures already executed in the country without the intervention of the Director-General of Stores. But this is nothing to the folly of having to *double* the contract period for the erection of a certain Court House in Bengal simply because—with thousands of tons available in the local market—the contractor has to await the pleasure of the Secretary of State in respect to obtaining the few tons of iron joists he requires to complete his undertaking. *Verb. sap.*

Current News.

The Simla Fine Arts Exhibition will probably open during the last week of September.

Captain J. Hext, Director of Marine, left by yesterday's steamer from Calcutta on a visit to Burma.

Sixteen and a quarter millions of gallons of kerosine oil were imported into Calcutta from the United States last year, but it is doubtful if Russian competition can be resisted much longer.

Maung Pe Maung has been elected to an engineering scholarship of Rs. 60 per mensem, tenable for five years. On completing his college course, the student will be posted to the P. W. D., Burma.

The appointment of Dr. G. Watt, C.I.E., as scientific assistant in the Revenue and Agricultural Secretariat, has yet to be sanctioned by the Secretary of State for India, before whom the papers now are.

At a recent meeting of the Municipal Commissioners it was resolved to give their Engineer special powers to enable him to cope more satisfactorily with the present most wretched state of the Madras roads.

The opening of the Balawali Bridge on the Northern Extension of the Oudh and Rohilkhand Railway (between Moradabad and Roorkee) was the occasion of a grand ball at Balawali on the night of the 6th instant, which was a great success.

There appears to be a likelihood of an increase of traffic over the Sind section of the North-West Railway, as the United Railway and Government Servants' Association have been indented upon for engine-drivers for that particular line.

The E. I. R. Company, as an experiment, are running a train of 1,000 tons from Howrah to Delhi. Two engines work the train on the chord line in consequence of the heavy gradients. We have not yet heard how the experiment answers.

Mr. Horace Bell, the Manager of the Tirhoot State Railways, will officiate as Manager of the North-Western system of Railways during Colonel Wallace's absence on leave to England. Mr. F. J. Spring, the Under-Secretary in the Public Works Department, Bengal, is to act for Mr. Bell as Manager of the Tirhoot Railways.

The Burma State Railway may be said to be paying its way now. The Railway authorities are working with much spirit, now that they have the Toungoo-Mandalay Extension on hand. It is generally believed that the Irrawaddy Flotilla Company will suffer to some extent when the iron horse puffs his way direct to Mandalay.

A Mandalay correspondent writes :—Every outstation having now been connected by telegraph with the head-quarter stations, the telegraph section of the Madras Sappers and Miners has left for Bangalore. They deserve well of their country, as under very trying circumstances they have placed a network of wires all over the newly-acquired region.

The Lucknow-Sitapur-Kheri Railway has just been tested by the first outburst of the monsoon, and, we regret to learn, has been found wanting. On the 15th instant the train from Lucknow to Sitapur was eight hours late owing to the overflow of a watercourse which caused a temporary break in the line. The damage appears to have been repaired.

Mr. Geoghegan, the Engineer-in-Chief of the Madras State Railway Surveys, is at present preparing plans and estimates and drawing up a report of the Villapuram, Paikul and other projected State Railway Surveys, for the transfer of which the South Indian Railway authorities, under instructions from their Board of Directors, are at present negotiating with the State.

The cotton spinning industry in the Nizam's Dominions, which is at present represented by two mills, those of Hyderabad and Kulburga, is receiving a fresh and very important impetus in the formation of a company in Aurungabad to erect and work a mill there of 16,000 spindles and 1,000 looms. The capital of the company is fixed at six lakhs in 1,200 shares of Rs. 500 each.

Mr. C. Knapp, an Executive Engineer of the Madras State Railway Surveys, has assumed charge, temporarily, of the duties of Deputy Consulting Engineer for Railways, Madras, pending [illegible] Jopp, R.E. taking up the appointment, as it is found impracticable to get on with the work of the department, especially in regard to inspections, with only one officer at head-quarters, Major Sydney Smith, R.E.

According to a contemporary, a case of some interest to Municipalities has lately arisen in Southern India. It appears that a Municipality wanted to impose a tax on the land and buildings held by the Railway within Municipal limits. The Railway, however, repudiated all liability, on the ground that it was not the Municipality but the State who owned the land held by the Railway. The question is, it is said, likely to get into the law courts.

Mr. J. Oates, the Controller of Stores of the East Indian Railway Company, having proceeded to Darjeeling on short leave, Mr. H. Wood, the Store Accountant, has been appointed to act for him during his absence. It is said that, on being relieved of his present temporary duties, Mr. Wood is likely to take up his new appointment as Assistant Controller of Stores, the Government of India having recently sanctioned the creation of that post. It is also rumoured that Mr. Wood intends, at no distant period, to proceed home on short privilege leave.

An interesting forecast of the monsoon has been issued by Mr. John Eliot, the Officiating Meteorological Reporter. Mr. Eliot lays far less stress than Mr. Blandford on the Himalayan snowfall, and much more on the existing meteorological conditions in India. Judging by these he anticipates that there are likely to be good rains in North-East and Northern India ; that the Bengal current will be strong and early, and the Bombay weak and late ; and that the Punjab and in a less degree the Central Provinces are likely to come in for particularly abundant rains.

Letters to the Editor.

[*The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by correspondents.*]

RANGOON CATHEDRAL.

Sir,—In reference to your note on the terra cotta for Rangoon Cathedral allow me to make a few emendations ; The name of the contractors should be Messrs. Robinson and Drury ; the name of the architect is Mr. Chisolm ; the style of the architectural terra cotta intended for the Cathedral is Gothic—Early Decorated—while that of the Financial Buildings at Calcutta is late French Renaissance.

Architect.

A RATIONAL SUGGESTION.

Sir,—It may be interesting to your readers to see a paragraph in an article "The Imperial Institute" in the *Westminster Review* for April last, which is as follows ;—" Neither do we mean by practical men Royal Engineer Officers, whom it is rumoured there is some intention of thrusting into the Intelligence Department of the institute. That corps must be kept out at all costs—if the business men do not wish every post in the Institute soon filled by Royal Engineer Officers."

Civis.

SEEBPORE ENGINEERING COLLEGE.

Sir,- I learn that the authorities are obtaining information with a view to so improve this Institution as to make it more popular than it is at present. I note, however, that although the "Entrance" tests have been higher in the Madras College of Engineering, the latter has only quite recently assimilated its curriculum to that of Seebpore, by extending its course to five years. But Roorkee still holds the advantage of a shorter course of study, and it is this absence of uniformity that induces me to address you.

Ex-Stud.

SILK FILATURES.

Sir,—I have the honor to enclose herewith copies of translations of two letters regarding experiments for the stifling and drying of the chrysalises of Cocoons with Gauthier's apparatus—described in your issue of the 19th February. It will be easy from these letters for you to understand how well goods by this apparatus are treated. I send this information as a sort of a supplement to that already published in your Journal.

You will see that the experiments for drying silks, chussums stuffs, wool, goat's hair, cotton, straw and felt hats, *pâtes alimentaries*, starch, &c., which were made at Lyons, Valence, Alais and Marseilles, all gave good and conclusive results.

The apparatus, as you are aware, is very simple and consists of two combined chambers according to the requirements of the industry and of the quantity of merchandise to be dried; if it can be constructed in a manufactory where there is a steam boiler, its expenses and keep are trifling. As you can see, this apparatus is applicable to all the merchandise which requires a prompt desiccation or drying ; merchandise treated by this system can never be

burnt nor deteriorated, as one sees continually by other systems, when the hot air cannot be regulated.

TUSSER.

THE BENGAL-NAGPUR RAILWAY JUNCTION.

SIR,—Your correspondent "A" has somewhat overstated the suitability of Govindpur as the point of junction of the East Indian Railway with the Bengal-Nagpur Railway, in comparing it with Asansol as the place of location of the said junction. He has lost sight of an important factor in the economy of Railway administration, *viz.*, the working charges on the extra distance run, which unlike the construction charges incurred once for all—comparatively speaking—will be perpetual or as long as the Railway lasts! "A" is in error in thinking that the value of land at Asansol is prohibitive or higher than at the locality he speaks of. The land at the place referred to by "A" may be valueless now or cheaper than obtainable elsewhere, but the moment circumstances point to the probability of a Railway through it the value will soon go up. Perhaps it will be information to "A" to learn that the alternative alignment from Asansol passes through a tract of country geologically described as *non-carboniferous* and that the owners and proprietors of the same are willing to treat with Government on the easiest possible terms. "A" is far from being right in thinking that the preferential line from Asansol will prove non-productive, as there are known fields of coal, iron and lime-stone in the neighbourhood of the line, which when developed will contribute largely to its revenues.

X. Y. Z.

THE E. I. R. NEW FERRY-STEAMER.

SIR,—It will perhaps be interesting to you and to some of your readers to know that the East Indian Railway Company are going to relieve their old steamer *Kashejee*, at Sahibgunj, of a good deal of its labors which have of late been increased by the opening of the Assam-Behar Railway. She had done considerable service before the Company got her upwards of 25 years ago, and although repairs have been done from time to time, she has been running constantly ever since being put on the Sahibgunj Caragolla Ferry in 1864, and is entitled to superannuation. She is, therefore, to be replaced by a new steel steamer of more modern principles, built in accordance with the design of the Locomotive Superintendent submitted under Indent.

This steamer is being fitted and erected and partly constructed by the Locomotive Department of the Railway at the Jubilee Bridge yard, where we have the benefit of what can be of service from the shops and stores belonging to the bridge.

She is a first-class vessel built entirely of steel (Siemens Martin) of the following dimensions.

Length over all	170′ 0″
Breadth moulded	24′ 6″
Do. extreme	40′ 6″
Depth moulded	8′ 3″
Draft in working order	3′ 0″

The principal feature in the vessel is its light draft, securing neatness of design. All the frames, deck beams and other steel angles are rolled to special sizes by which the greatest rigidity is obtained with the minimum amount of metal.

The engines are compound, surface condensing, direct acting on the diagonal principle, working a pair of feathering paddles 14 feet diameter. The cylinders are 48″ and 27″ diameter with 3′ 0″ stroke taking steam from two boilers of locomotive type at a working pressure of 100 lbs. per square inch.

The engines are so designed as to have the cylinders at one end and the condenser at the other. Both being bedded together by distance pieces on the engine stools below, and by the diagonal main stays above. By this arrangement the engines are entirely self contained, the entire strain being taken up by the body of the engine on the one hand and the paddle shaft brackets on the other, without throwing any steam on the engine beam.

The boilers are of Lowmoor iron with brass tubes the draft being kept up by an independent fan and engine. The safety valves on the boilers are made to discharge the escape steam downwards through the hull bottom, to prevent annoyance to passengers.

In general the vessel is fitted with all the latest improvements such as steam capstains, steam winches for the holds, improved telegraph between engine-room and steering deck, and improved steering gear dispensing with outrigger.

The awning, roof, main and steering decks, ladies' and gentlemen's saloons with all the necessary comforts for passengers, will be finished by the middle of September, and the vessel may be expected to be ready for work shortly after and the travelling public who have to make the journey by this steamer will, no doubt, appreciate this improved accommodation.

M. I. M. E.

Literary Notices.

DYNAMICS FOR BEGINNERS. *By C. B. Lock, M.A.* London: Macmillan and Co. 1887.

IN our issue of 12th March we discoursed somewhat generally on the subject of Mechanics. The work now before us could hardly be brought under the category of those discussed, as it only explains the *elementary* principles of a part of the subject; but the new departure made in it in the treatment of this branch of mixed mathematics is in every way worthy of attention as a good introduction to the study of applied as well as theoretical mechanics. It combines the advantages of simplicity and clearness for beginners with due regard to scientific accuracy. The first part treats of Linear Dynamics, which is the feature of the book. The next on "Motion in one Plane,' '*i.e.*, *Direction*. Section III is devoted to Illustrations and Section IV. to Energy. Care has been taken both in the text and the examples to use uniform and precise terms, and some suggestions are made as to *names* with the view of preventing that confusion of ideas so common with beginners. The result on the whole has been a simple and clear exposition of the first principles of a branch of study beset with difficulties.

THE WORK OF THE IMPERIAL INSTITUTE. *By Sir Frederick Abel, F.R.S.* London: William Clowes and Sons, Ld. 1887.

THIS Pamphlet contains the Address delivered at the Royal Institution in April last by the distinguished Scientist who took such a prominent part in promoting the Indian and Colonial Exhibition. The Address has already appeared in most of the newspapers; but the Statistics appended to it to illustrate the development of the British Colonies during the Queen's reign are instructive. We find that the Imports and Exports of all dependencies of the Crown, taken together were *eleven times* larger in 1885 than they were in 1837, while the population has increased more than fourfold. This evidence of prosperity should secure unity as a means of strength to Her Majesty's Realms.

ENGLAND AS A PETROLEUM POWER. *By Charles Marvin.* London: R. Anderson and Co. 1887.

THE author of the "Petroleum Industry of Russia" has essayed to shew that there are similar factors or "New Fields for British Enterprise within the Empire." His contention is "India's Petroleum for India," and, therefore, having annexed the Burmese Oil Fields we should work them. He considers it an anomaly that India's Petroleum deposits on steamer-traversed rivers should "remain ignored, undeveloped, idle." But he apparently forgets that efforts are now concentrated in regard to utilising "India's Petroleum for India's Railways." We refer to the oil deposits of "Sibi" and "Pindi" on our North-West Frontier. His arguments, however, are sound, and the cause he advocates is worthy of the attention of British enterprise. The *brochure* is produced in the style of Mr. Marvin's other orange wrapper shilling pamphlets and affords an hour's easy agreeable reading.

Among late works upon Electricity, one by Linnæus Cumming, entitled "Electricity Treated Experimentally," for the use of schools and students, is meeting with an active sale, it is a 12mo. volume of 389 pages, with 212 illustrations.

A recent work by P. M. Randall, author of the "Quartz Operator's Hand Book," entitled "Practical Hydraulics," deals with the usual questions of flow of water in pipes and open conduits, and is accompanied by a series of tables of computation of velocities, etc. These tables are made out in terms of feet measures not metrical, for which Mr. Randall claims an advantage. While the work is largely a compilation from various sources, there are additions of a somewhat original nature, and the practical examples given add to its value, especially for others than the skilled engineers. As the author has given his attention largely to mining engineering in California, we presume this present work of his will be found to be admirably adapted to the wants of the hydraulic mining profession.

General Articles.

STEEL AND IRON BRIDGES FOR DISTRICT ROADS.

THE importance of road bridges in India, and the large annual expenditure therefor, will, I feel assured, be readily accepted as a sufficient apology, if such be necessary, for again returning to this question, especially when on this occasion I am able to introduce to your readers information regarding composite steel and iron lattice girder bridges which seem to me to possess many economic advantages.

It is, of course, well-known that there are two systems of iron bridges which possess somewhat distinctive features, each with special advantages for certain specific purposes. I refer, of course, to bridges formed of solid or rolled girders and to those of the lattice girder type.

The rolled girders can be most economically applied to spans of about 20ft., and 25ft. may be taken as the maximum.

Lattice girders, again, are the most economical for wide spans up to about 100ft. without any intermediate pier, but when a series is necessary, spans about 60ft. each are found to be the most advantageous. I have received a series of designs of both of the foregoing types of bridges by Messrs. A. & J. Main and Co., of Glasgow, London and Calcutta, but it is specially in regard to the lattice girder bridges to which I would call attention. Starting with the practical consideration that piling when wide rivers require to be bridged, is an expensive process, their *first* object has been to reduce the use of iron piers *to a minimum*; and *secondly*, in the formation of the lattices themselves to introduce the use of steel as far as possible so as to secure the maximum strength at the minimum weight of materials and consequently of cost. As the majority of Indian rivers are of such a width as to require several spans, it becomes a subject of considerable interest to ascertain how, in bridging wide rivers, the two systems I have referred to compare as regards cost.

As already stated, a lattice girder of about 60ft. is found to be the most economic, and if a single span of this width is taken, I am informed that for a timber roadway, and of a strength to carry 120lbs. per square foot, a bridge of this type can be delivered at an Indian seaport for about Rs. 1,600. The girders would be formed partly of steel and partly of iron, but, of course, if a concrete roadway were adopted they would have to be stronger and the cost somewhat more. Turning now to the solid girder type of bridges, there would, of course, be required three spans of 20ft. each, with two intermediate piers, the cost of which would be quite Rs. 3,000. But this is not all the difference in cost, as there is the screwing or driving of the two intermediate piers to take into consideration, not to speak of the element of danger introduced from "foreign matter" being carried down by the current. If we now apply these figures to a river, say, 180ft. wide, we will get at the cost of piling in both cases. In arranging their iron piers, Messrs. Main and Co. prefer to adopt four piles in each, of a suitable strength and diameter, as affording greater security to the structure than piers constructed with two piles only of a proportionately greater diameter, and in bridging the span we have imagined there would be required three spans of 60ft. with two intermediate iron piers, the total cost of which would be about Rs. 8,850. In the case of a solid girder bridge, nine spans and eight sets of piers would be necessary for the same length, the cost of which cannot be taken at less than Rs. 10,000, while it is obvious that the cost of erection and the element of obstruction are vastly increased. The results which these calculations bring out (and the figures, I believe, may be taken as correct) show conclusively that in the designs which Messrs. Main and Co. have worked out, most important savings in the cost of road bridges are effected.

The illustration, which I am enabled to give shews a design submitted by Messrs. Main and Co. for bridging a river in Bengal 300ft. wide in five spans with a section of 20ft. at one end to open for the purposes of navigation, and to cost Rs. 22,000 delivered in Calcutta or Bombay. The opening section is placed at one end for a specific object, but it can, with equal facility, be applied to any other position in the bridge, the only change in the arrangement being an additional iron pier and a few other details. The method of working this opening section has been patented by Messrs. Main and Co., and as it is moved in one piece at one operation by hand power, it obviously possesses most important economic considerations in the bridging of navigable rivers.

On the whole Messrs. Main and Co.'s designs seem to me to be well adapted to Indian requirements, and, covering as they do such a wide range, they will be of special interest to Engineers and others interested in bridges for district roads.

D. E.

THE STEAM ENGINE AND ITS HISTORY.

STEAM is an elastic fluid into which water is converted by the continued application of heat. From the primary step of bringing warmth and light into our dwellings, it became the impelling power in every description of art and manufacture, by its introduction in converting the alternate strokes of a piston into a rotary motion. It presents to the world, that greatest of modern wonders, the "Steam Engine," which has been destined to exert such a vast influence on the fortunes of mankind. Applied to many different purposes its ultimate object, as we are all aware in every case, is the economy of time, the most valuable of human possessions.

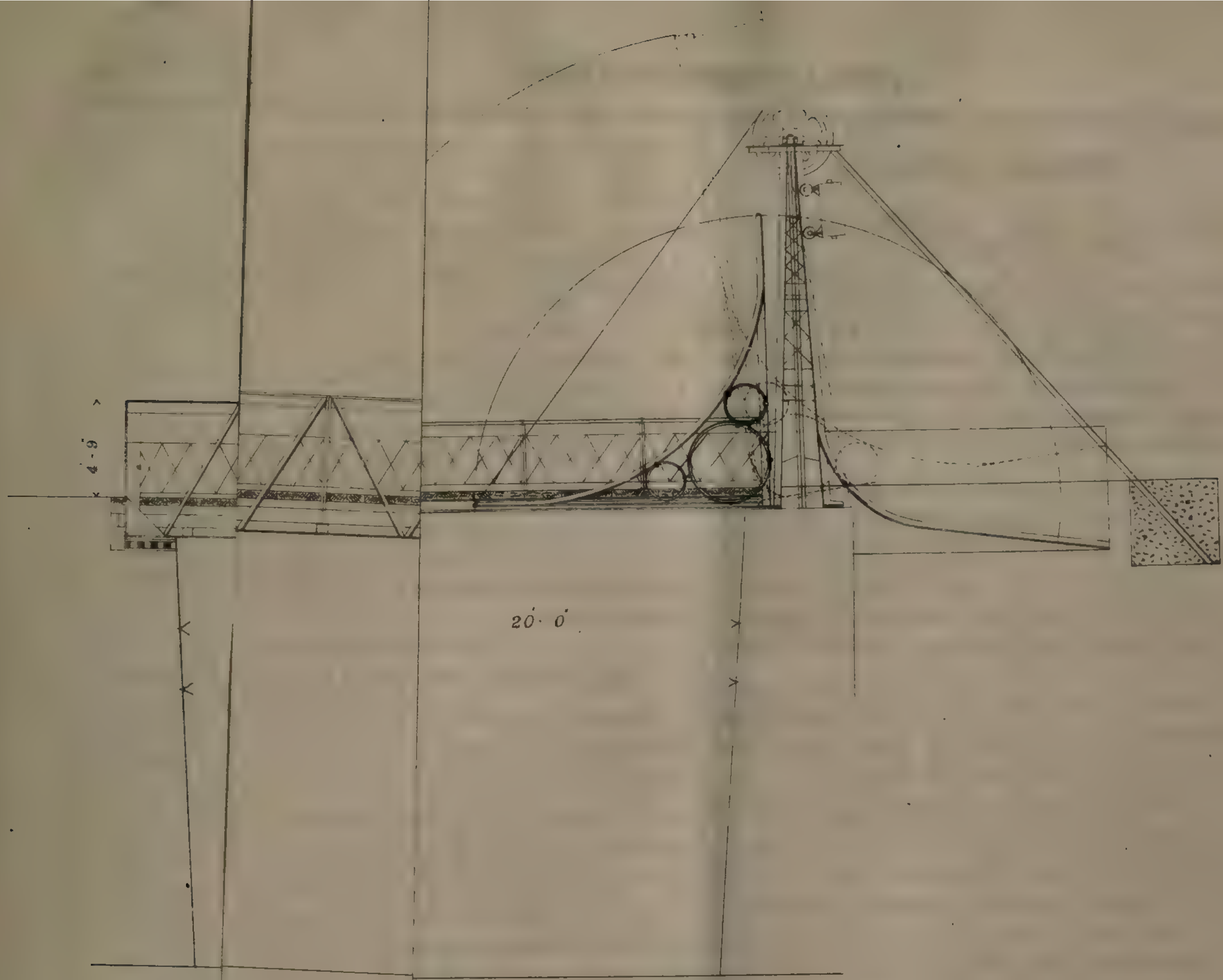
Steam, as a motive power, cannot very well be said to be a discovery of any recent date, we have records which teach us that its use must have been partly known to the ancients. We hear of Hero of Alexandria, 130. B.C., who constructed a small apparatus by which a revolving motion was given to a ball, suspended on two upright tubes inserted in a cylinder in which steam was generated through the action of a lamp placed below. There is a very remarkable passage in Homer's Odyssey which impresses one with the belief that these ancients must have had an *idea* of the probability of some great agent being impelled at some future date to act in the place of man and beast.

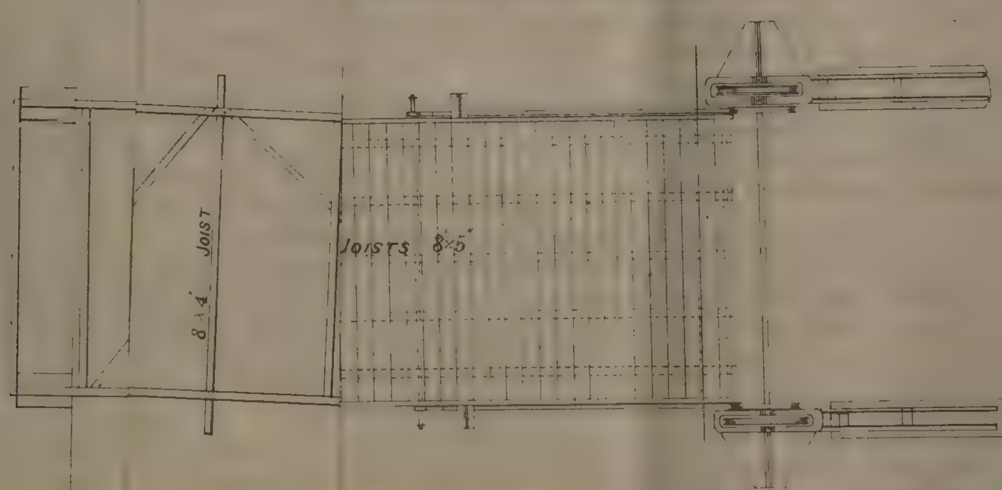
"So shalt thou instant reach the realm assign'd
In wondrous ships, self-mov'd, instinct with mind."

In a trifling dispute relative to the walls and windows of their contiguous houses, Anthemius, architect of the Emperor Justinian, had been vanquished by the eloquence of his neighbour Zeno; but the orate was defeated in his turn by the master of mechanics, whose malicious, though harmless, stratagems are darkly represented by the ignorance of Agathias. In a lower room Anthemius arranged several vessels of water, which were covered in, and with these he connected leathern tubes, leading them up to the roof of an adjacent building and having placed these among the rafters and joists, he set to and kindled a fire beneath the vessels, the steam of the boiling water ascended through the tubes, the house was shaken by the efforts of the imprisoned air and its trembling inhabitants might wonder that the city was unconscious of the earthquake that they had felt. The orator declared in a tragic style to the senate that a mere mortal must yield to the power of an antagonist who shook the earth with a "*trident of Neptune*"

We may now rightly call the three great applications of Steam, namely, the Land Engine, the Locomotive and the Marine Engine, the "Trident of Neptune." for have they not convulsed the Earth by the wonderful changes they have effected?

Let us turn our attention to those who have been chiefly instrumental in bringing the qualities of the Steam Engine to the notice of the public. Several had given it a thought, a few had actually experimented and tried to prove the usefulness of their appliances, but





… of Loads on each Main Girder; to carry 120 lbs. p. sq. ft.

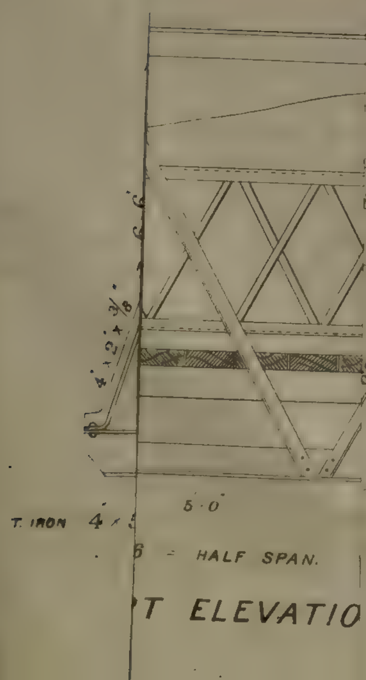
…d = 52·5′ × 6′ = 315 sq. ft. @ 120 lbs. or 1·07 cwts. = 337 cwts.

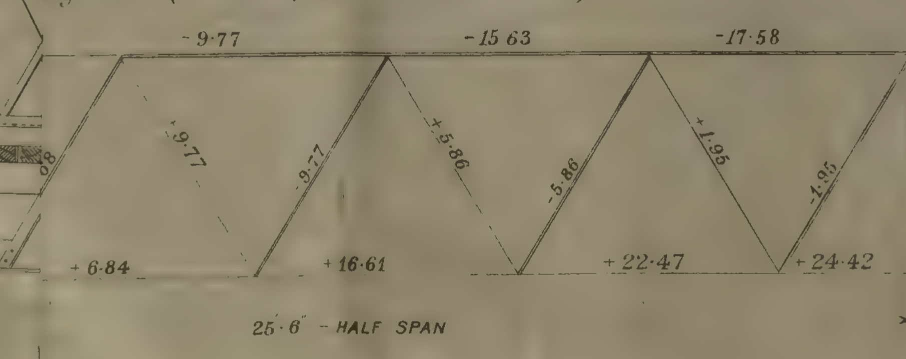
Weight of ½ Structure = 52·5 ft. × 1⅛ cwts = 59 ″

Concrete Roadway. 315 × ·45 = 141·75 × 1·07 cwts = 152 ″

Total = 548 cwts or 27·4 Tons.

…ns per Triangle Summit, inducing the Strains in Tons shown in the …iagram: – (– for Compression, + for Tension.)





The "Star" Press, 19 Lall Bazar Street, Calcutta.

these simply sprung up like bubbles on the ocean, appearing every now and again and after creating some slight bluster have disappeared, not to be seen nor heard of any more. In the year 1543 A.D. Blasco de Garay, a Spaniard, propelled a small vessel at the rate of three miles an hour, but owing to the disturbance of the time he had relinquished all hopes of furthering his experiments. In the year 1563 some mention was made of the name of Mathias, a Frenchman. Solomon de Caux in 1615 wrote a book on the properties of Steam. Giovanni Bianca, an Italian, did a little more in 1629.

But it was the Marquis of Worcester who first set the example to our nation and roused the " giant" from his lethargy to assist in the world's progress. Having gained an insight into an experiment made by one of these ingenious foreigners ; Worcester bethought of revealing the secrets of this great adventure to the people of his own country and after practically testing the usefulness of his great discovery by inventing a small machine which he had designed for the purpose of pumping water, he began to impart the knowledge thus gained to others and wrote several books on the new motive power ; and thus reset the young plant which he uprooted from a foreign land and which was destined to attain to the enormous proportions of a mighty tree, with its numerous scattered branches ; thanks to the fostering care of those excellent men—Watt, Stephenson, and Bell, whose history we shall presently review.

In the year 1702 there appeared a description of an Engine in the *Miners' Friend* by a Captain Savery for pumping water, on the vacuum principle ; his patent was " for raising water and occasioning motion to all sorts of mill work by the impellant force of fire." Three years later, Thomas Newcomen, of Darmouth, invented his atmospheric Engine, introducing the cylinder and piston and thereby the " reciprocating motion. " This was the first stage the Engine had arrived at, and the attempt made was a very good one, but, of course, there were several defects, and as yet it was in a very crude state. In the year 1759 James Watt, a native of Greenock, who was employed as a mathematical instrument maker at Glasgow had his attention drawn to the invention by a Dr. Robinson and in 1763, when only 17 years of age, he was called upon to repair one of Newcomen's Engines and having taken particular notice of the several details in it, he shortly after constructed one himself and was able, after a few experiments, to distinguish what was wanting to make the machine perfect, and shortly after presented to the world those great improvements which have made his name so famous, and in 1776 his Engines were used in all Manufactories : but he seems to have confined his studies to Land Engines, and working by expansion or low pressure steam and quite disapproved of anything further than this, for we hear of him having reproached one of his assistants, Murdoch, with wasting his time for having conceived the idea of constructing a steam carriage. In 1778 he patented his Expansion Engine and in 1781 his double Expansion Engine. To conclude the first part of this essay, the history of the Land Engine, and to give one an idea to what extent this great work has risen, the following will prove interesting. The largest pump in the world at the present day is in America and is used to pump water out of the mine near Frendensville, Lehigh country. The cylinder of the Engine has a diameter of 110 inches, the piston rod 14 inches and the stroke is 12 feet. In one minute it forces over 20,000 gallons of water out of the mine to a height of 130 feet. The length of the plunger is 200 feet. The two fly-wheels weigh 64 tons each and the beam is nearly 50 feet long.

In 1769 M.Cugnot made a steam carriage for driving artillery. In 1784 Murdoch made a model of a Steam Engine. Trevithick was the first that discovered the power of high pressure steam and after several successful experiments he introduced his Locomotive in 1803. The first Engine constructed in America was by Oliver Evans, who has been styled the James Watt of America. In 1801 he brought to notice his celebrated Engine, the " Eructor Amphibolis," which could be used both on land and water and he invented several steam contrivances for grinding flour, sawing stone, &c. Matthew Murray in 1811 invented the double cylinder, right angle crank, and D-valve. Timothy Hackworth invented water tubes, boiler flues, the return flue and tubular boiler, the dome, the water gauge, springs to safety-valves and bearing springs. In 1813 William Hedley discovered and proved the usefulness of the smooth wheel for traction. In 1814 the *Times* newspaper was printed by steam.

(To be continued.)

SEWERAGE SCHEME FOR KARACHI CITY AND ITS SUBURBS.

J. STRACHAN, M. INST. C.E., MUNICIPAL ENGINEER.

(Concluded from page 361.)

VI.

Flushing Arrangements.

34. Wherever deemed necessary by the Engineer proper flushing gates, pen-stocks, flaps, or other suitable flushing valves shall be provided in the manholes, or other special shafts intended to be constructed as flushing chambers for the purpose of flushing the sewers ; and in all such cases the flushing apparatus shall be so arranged that when closed there shall be a sufficient overflow provided to allow of the passage of sewage, when the water has reached the height assigned to it by the flushing arrangements.

Sewers not to join at same level.

35. Street sewers of different sizes should not join with their inverts at the same level, but, as a rule, in the case of circular sewers with their respective centres on a level, or where the available fall admits of it, both for circular and egg-shaped sewers, with their soffits level. Where the latter is not practicable, on account of the levels, it should be endeavoured to place the springing of the arches of egg-shaped sewers at the same height. In the case of pipe sewers joining or bending sharply in a manhole at an angle or change of direction, an extra fall of from 2 to 4 inches, as far as the adjoining gradient admits of it, must be given to counteract the increased friction of the angle. An increased fall is also necessary in the case of lampholes placed at sharp bends of sewers, in which case the extra fall must be given to the sewers in the invert.

Sewers in Straight Lines.

36. Pipe sewers, or sewers of less size than 2 feet diameter, must be laid out in straight lines with easy curves, where deemed necessary, of from 10ft. to 30ft. radii at their junction with stone sewers, the junction being effected at an angle of 60 degrees with the direction of the flow. The obtuse angle thus formed with the straight line of a pipe sewer is to be converted into an easy curve, at the end of which a lamphole should be placed. Manholes or lampholes are then to be placed at all angles or changes of direction or gradient in the sewers, so that, for instance, by placing a lamphole at an angle formed by two straight lines of sewer changing direction, either line of sewer can be fully inspected from a manhole placed at the end of each line, when a lamp is lowered down the lamphole, or *vice versâ*, from a manhole at the angle, when lamps are lowered down lampholes placed at each end of the two lines. The straight lines of sewer are to be divided up by immediate manholes or lampholes not more than 40 yards apart, so that any defect or stoppage can at once, by means of the shafts, be examined and localised to a length of 40 yards.

Sight Rails.

37. In order to secure accuracy of line and gradient in the construction of sewers it will be necessary to fix posts and sight rails before commencing the work at not more than 50 yards apart, shewing the exact centre of sewer, and fixed at a certain regular height above the invert, so that by using a boning rod of that length be-

tween any two sight rails the exact level of the invert of sewer will be obtained. These rails must be checked both as regards level and line, from time to time during the progress of the works.

Dead Ends.

38. All sewers must be so arranged, wherever practicable that there shall be no dead ends except when adequate provision is made for the satisfactory flushing of the length or lengths of sewer in question, and on its being shewn that the sewers can at any future time be joined to one another at the proper levels in the circulating system.

Materials and Construction of Drains.

39. The drains of all houses and buildings shall consist of glazed stoneware or earthenware pipes of the description set forth, or of cast iron not less than three-eighths of an inch thick, varnished inside and outside with varnish to be approved by the Engineer or in the case of vertical soil or other waste pipes, of lead not less in substance than would be equal to 6lbs. per square foot. All pipes must be laid with water-tight joints, as already described for street sewers, and in the case of stoneware pipes underneath houses they must be made with Portland cement joints, and surrounded with not less than 6 inches of concrete, of the proportion of 1 of cement to 8 of gravel, or 1 of the best ground lime to 5 of gravel.

Drains Outside the Houses.

40. The drainage of any house or premises must be so arranged that wherever avoidable, even though the length of drain may be increased and the fall less favorable, it shall not pass underneath any house or part of a house. Where, however, this is not practicable, the drain must be surrounded with concrete as set forth above, or consist of varnished cast iron pipes with lead and gaskin joints. Where the covering of the pipes underneath any house is less than a foot, the latter material should be used.

Gullies.

41. The gully grates and traps to be used for house drainage purposes are to be of the same construction and principle as those specified for streets, *viz.*, side outlet double-trapped and bottom outlet treble-trapped gullies, with removable sludge-boxes. In size they are not to be less than 10 inches by 7 inches top outside measure.

Disconnecting Drainage from Interior of Houses and Ventilation of Drains.

42. All drainage from the interior of a house, or other building must, wherever practicable, be disconnected, in such a manner that the air connection between the drain or sewer and the interior of the house or building is for all practical purposes cut off. The drainage from baths, &c., is therefore to be delivered on to trapped gratings placed outside the house, and, wherever possible, in compounds or areas. Wherever the soil pipes of water-closets are placed inside a house or building they should be disconnected, if possible, by a ventilated siphon. No ventilated disconnecting siphon or other shaft covering can be permitted, however, in the foot way of any street. If, therefore, there be no area in front of a building into which a disconnecting siphon can be prudently ventilated, a special ventilating pipe must be carried up from the siphon to the eaves of the roof.

Soil Pipes.

43. Soil pipes placed vertically may be of lead, not less than 6lbs. to the square foot; or of cast iron, not less than ¼ inch thick, coated inside and outside with Dr. Angus Smith's patent varnish, and jointed with lead and gaskin. They shall not be less than 4 inches nor more than 5 inches internal diameter, and should, wherever practicable, be placed outside the house or building in which the closets may be placed. All soil pipes from water-closets, within a house or building, must be extended the full bore, unless otherwise specially sanctioned up to and above the eaves of the roof.

Water Closets.

44. In placing water-closets within any house or building care should be taken that one side or end is made an outside wall wherever practicable, in order that light and ventilation are secured. The principle of construction of all water-closets shall be subject to the approval of the Municipality. Every closet must be fixed, as the particular case may require, on an enamelled iron, lead or stoneware siphon, with not less than 1½ inch to 2 inches dip to form the trap. The common form of D trap will not be permitted. Great care must be taken that the connection between the water-closet apparatus and the siphon and the joint of the siphon with the drain or soil-pipe are both made sound, and air and water tight, and with such materials as are not likely to contract or expand, or be affected by the urine passing over them into the drain or soil-pipe. All closets placed inside houses or buildings should be provided with a safe below the seat, of lead or zinc, to prevent fouling the floor in case of an overflow of the basin or leakage from a defective joint above the floor. The outlet pipe to this safe should go outside the building, so that any defect would at once be observed, but its outlet end should be protected by a small flap valve, to prevent a back draught under the closet seat. The seats of all water-closets in the interior of dwelling houses should be made to slide or lift up, so that the space below the seat can be periodically examined.

Cisterns.

45. The overflow pipes from all cisterns and service boxes must either go direct into the open air or be carried by means of lead or other suitable pipes to a proper trapped gully or siphon placed outside the building.

Sinks and Slopstones.

46. No stone shafts will in future be permitted for carrying the waste water from the kitchen sinks to the gratings or drains. Proper lead or iron pipes, of not less than 1½ inch diameter, must be affixed to the sinkstones to carry the water outside the building on to the top of a proper gully or to the socket branch of a ventilated siphon or similar suitable arrangement. The inlet of such pipe should be protected by a siphon or other suitable trap, to prevent a current of air passing through the pipe into the interior of the house.

47. *Estimate of Kurachi Drainage.*

1.	27,900 Lin. feet intercepting sewers	Rs.	1,22,397
2.	Outfall Sewer including Reservoir	„	52,709
3.	Rising Main cast iron	„	1,15,262
4.	Pump Well	„	1,118
5.	Tumbling Bay	„	638
6.	3 35 H.-P. Engines including Boilers, Pumps and all necessary buildings and fittings	„	72,500
7.	Works at Sewage Farm	„	60,000
8.	Cross drains in Town and Camp including excavation, laying and jointing, filling in and repairing roads where injured	„	2,62,500
9.	Lampholes, Ventilating Shafts, Manholes ...	„	33,295
10.	Latrines and Urinals	„	20,000
	TOTAL Rs. ..		7,40,419
	Add five per cent. Contingencies		37,000
	GRAND TOTAL. ...		7,77,419

NOTE ON IRRIGATION IN THE MADRAS PRESIDENCY.

By A. PIERRES DECLOSETS, C.E., F.R.S. OF ARTS AND SCIENCES, MAURITIUS.

II.

THERE is no means of improving these machines, which are of the simplest description, but I will call the attention of the Government to the advantage which may be secured by employing the power of the wind, power which costs nothing; but there a difficulty arises, that is, to construct a machinery such that the cost should be in accordance with the pecuniary means of the ryot, and such, that the repairs, or even the construction of the machine acted on by the wind, could be done by a common village carpenter or blacksmith.

Machinery procured from Europe will be out of the question, as too expensive, although rich zemindars may avail themselves of such machinery, but what is wanted generally is something cheap and effective.

I hope I have been able to arrive at securing the above advantages, by the construction of a windmill revolving

horizontally, moved by wind from any point of the compass, and constructed entirely with materials at hand in every village. This windmill could work pumps, norias, or other machinery for raising water, and could be established everywhere, on tanks, streams, or wells; if the wind fails, a pair of bullocks tied to the mill, will continue the work.

The mill proposed, such as the one now erected in the neighborhood of Trivellore, consists of an upright shaft, on which are fixed 4 arms, supporting each a sail; two of these sails are constantly under the influence of the wind, producing thus a rotatory motion of the shaft; upon this shaft or spindle, and below an earthen platform above which revolves the arms of the mill, a pulley is fixed on the shaft, and this pulley drives, by the means of an endless rope, the driving pulley of a noria, with buckets hung by iron links articulated so as to pass upon the gear of the noria. Each bucket contains one cubic foot of water, and the speed has been calculated, so that 60 buckets will deliver their contents within a minute of time, that is, at the rate of one cubic foot of water per every second.

The dimensions of this kind of mill could be increased, but I consider the actual size, as the most convenient for management by one man.

If the wind slacks or fails, as I have said, a pair of bullocks is tied to one of the arms, and walking round upon the platform, will continue the motion of the spindle and that of the noria.

When the velocity of the wind increases, the surface of the sails could be reduced by means of reefs.

One man can manage the mill, its power varies with the velocity of the wind, which is from 8 feet to 22 feet per second, giving then a power from 0·13 to 2·50 horse-power. The following table shews the quantity of water raised for a certain velocity of wind, the power employed, and the cost of the cubic foot of water raised at 14 feet.

Velocity of wind in feet per second.	Number of revolutions in one minute.	Volume of water in one minute.	Volume of water per hour.	Volume of water per day of 10 hours.	Cost of water per cubic foot.
Feet.	T.	C. Feet.	C. Feet.	C. Feet.	Pie.
8	5	30	1,800	18,000	0·002
22	10	60	3,600	36,000	0·001

The average cost per cubic foot will be with the mill 0·0013, and in comparing the cost per cubic foot of the three modes of raising water we have:—

	Pie.
Pecottah	0·0360
Cavalei or Mot	0·0150
Double Cavalei	0·0075
Horizontal Windmill	0·002
Do. Do. with bullock	0·004

If steam-power was used, the cost per cubic foot of water would be, with a centrifugal pump 18 inches diameter, driven by an engine of 6 H.-P., water being raised at 12 feet.

	Rs.
Fuel for engine, per day	5·00
Driver	1·50
Sundries, oil, grease, repairs	0·50
Rs ...	7·100

The centrifugal pump will discharge 2·25 cubic feet per second, or daily 81,000, and the cost per cubic foot will be 0·016 pie.

The cost of engine and pump, and of the maintenance of this machinery, is too high for the generality of the agriculturists in India; however, I think, it would be introduced with advantage in certain localities, where fuel could be procured at a moderate rate.

(To be continued.)

CALCUTTA PORT IMPROVEMENTS.

The Kidderpore Docks.

III.

History of previous proposals.

Under the pressure of the various proposals for providing for the wants of the shipping resorting to Calcutta, mentioned in our last article, and considering the inconvenience arising from the severance of Calcutta and the railways running into it by the river Hughli from Howrah and the terminus of the East Indian Railway, Government appointed a Committee—consisting of whom does not appear, but we think Mr. A. M. Rendel was one member—to consider and report on the junction of the East Indian Railway with the Eastern Bengal Railway by a bridge over the Hughli; on the formation of wet docks; and on other matters connected with the convenience of the trade and shipping of Calcutta, and this Committee submitted their report on the 16th March 1865. The first question that called for their consideration was—How to deal with the terminal station of the East Indian Railway; should it remain at Howrah; or should the railway be brought across the Hughli by a bridge, and a terminus be formed in Calcutta? The Committee found no difficulty in recommending the latter course, and they recommended that the bridge should be placed two miles above the Cossipore Foundry, as being the nearest safe site possible. The terminus of the railway being removed from Howrah, a good steam ferry would easily meet the wants of that place. The Committee considered that Sealdah would be the most convenient place for a suburban passenger terminus for the East Indian Railway, there being ample room on the land of the Eastern Bengal Railway for the passenger traffic of both lines, if a new passenger station for that company were constructed on the site of their goods station. The junction of the two railways would be near the Dum-Dum station, and from that point the line of the Eastern would be made over to the Western Company, a new line being constructed for the former at the expense of the latter. The Committee, after considering alternative plans, thought that every effort should be made to effect this arrangement, and that no other would be thoroughly satisfactory. In considering where the goods station of the two companies should be located, the Committee found it to be a fact that the trade of Calcutta required that the mass of goods for export required to be repacked in Calcutta, which involved their delivery by cart at the warehouses of the merchants, and that, though the construction of wet docks with warehouses attached might thereafter in some measure change the habits of the trade, meanwhile the requirements of the existing state of things must be met. "Hence a large ordinary goods station must be formed, suitable for the present condition of business quite irrespective of the question of docks. At the same time there can be little doubt that it would be a great advantage if the railway goods stations were near wet docks, should these be constructed." After discussing the comparative advantages of various sites, but apparently with the feeling that they would afterwards recommend a site for the docks above Calcutta, the Committee stated their conclusions to be—"that the public convenience will be best met by massing the passenger traffic of the East Indian and Eastern Bengal Railways at a high level at Sealdah, whence metropolitan or suburban passenger lines can hereafter be extended; the goods traffic being brought together to a central position on the bank of the Circular Canal near Chitpore. If these arrangements are, as the Committee believes, the best for the public, they must also, as a matter of necessity, be the best for the Railway Companies."

In connection with the railway arrangements, the Committee considered a proposal by Mr. Power, the Chief Engineer of the East Indian Railway, that the

earth required for the bank on the raised portion of the line should all be taken and carried by steam power from a single deep excavation. This arrangement would be certainly the most economical for Government and probably not more costly to the Company, and it would avoid unsightly and objectionable excavations along the foot of the embankment. But the Committee approved of this proposal because such an excavation would also form the nucleus of a wet dock (the metaphor is the Committee's own), and the site, estimated by Mr. Power to have an area of 30 acres, being taken up by Government, could be handed over free of cost for adoption for a dock basin. The temporary lines of road necessary for conveying the earth to the railway bank might conveniently be laid out so as to serve for the permanent approach to the docks and goods station. "On the whole," the Commitee said, "the economy of combining the construction of the new line of main railway with the excavation of a dock basin, and the formation of a railway goods station near it, will be very large, and the grant of the excavated site may be roughly estimated as equivalent to a contribution of at least £40,000 or £50,000 towards the expense of the docks."

Under the third branch of the inquiry intrusted to them, the Committee came to the conclusion that with a view to the improvement of the means of landing imports and passing them through the Custom House,—and in a previous report (not published in the volume under notice—No. CCIX. of the Selections from the Records of the Government of India, P. W. D.,) they had recommended the immediate construction of jetties, in connection with suitable landing sheds and warehouses on the Strand Bank between the Bankshall and Armenian Ghaut,—the whole area to be surrounded by an iron railing and placed to under proper Custom House control. Suitable arrangements were also to be made for the shipping of export goods from the sheds and jetties. These recommendations were made irrespective of any decision which might ultimately be come to on the subject of wet docks, the Committee being satisfied that the facilities suggested were urgently required for vessels which would not use the docks. And the Committee recommnended that the construction of the jetties and appurtenances should be undertaken by the Port Trust, which it had already been proposed to constitute. The Committee strongly recommended the adoption of screw-pile jetties instead of a continuous wharf-wall, as being the cheapest and simplest plan of providing the facilities required for the import trade.

With regard to the question of docks, the Committee of 1865 were of opinion that wet docks were as likely to be useful and to pay a sufficient dividend at Calcutta as docks at any other port, though they could not pronounce them to be then absolutely essential. The effect of the construction of the proposed jetties, and of the development of Port Canning on the Mutlah, must be awaited before any decisive reply could be given. In these circumstances they thought it unnecessary for Government to give direct pecuniary aid, or guarantee of interest, to any scheme for the construction of docks. But they went on to consider whether there was any sufficient general objection to the construction of wet docks at all, and what localities offered the greatest facilities for them. On the general score of salubrity, they thought that under proper supervision no reasonable ground would be left for refusing to accept the real advantages of docks only to avoid a somewhat speculative risk to the public health, and that a properly kept wet dock would be far more sweet and wholesome than most of the existing tanks in the suburbs of Calcutta. But having regard to the fact that the wind blew almost constantly from the south during the hot months, the formation of a dock at Kidderpur might reasonably be objected to owing to the risk of offensive effluvia being wafted thence up to Calcutta. The difficulty of providing dwellings for the crews of the ships in dock, whom it would unquestionably be necessary to put on shore, was next noticed, and the Committee specially commended the health and comfort of the European seamen to the care of the Government and of any company undertaking the construction of docks.* The deposit of silt, too, was a difficulty that must be faced; but it could be provided for by dredging. In considering the question of site for the docks the Committee observed that the cost of land must be high in proportion to the proximity of the site to the centre of business and to its consequent convenience. The two suburban sites at Chitpur and Kidderpur were, therefore, at a great disadvantage when compared with Howrah, Garden Reach, or Akra. The cost of the works would greatly depend on the depth to be excavated, which at Chitpur or Kidderpur would be ten or twelve feet greater than at Howrah or Akra. As regarded ready access to the railways the Howrah and Chitpur sites possessed great advantages over the others. In point of accessibility to the river, the proposed sites were considered to be on a par, except that at Akra, which was pronounced to have a doubtful facility. On the whole, the Committee was of opinion that the Chitpur site had greater advantages and was less open to objections than any of the others; but they did not entertain a directly unfavorable opinion of any of the other sites, except of Kidderpur, until by an experiment elsewhere it should be ascertained whether the sanitary objection to wet docks had any force. This conclusion in favor of Chitpur was said to have been arrived at irrespective of the saving in excavation that would arise from utilising the excavation to be made for the railway bank; but they were satisfied that this consideration would have prevailing weight with any company really intending to construct docks. The Committee had received, through the Chief Engineer of the East Indian Railway, a copy of a letter from Mr. G. Turnbull, the Engineer of a Company then lately formed in London—"The Docks and Warehouses Company of Calcutta," which seemed to mean business; and as this Company did not seem to have the intention of asking aid from Government beyond the grant of land, and the permission to levy dock dues, the Committee presumed that the Government would be prepared to deal with them. But considering that Mr. Prestage's Company, though it had asked for a guarantee, was the first to come forward, and that Mr. Turnbull's Company had not yet made any definite offer to Government, the Committee suggested that opportunity should be given to them to combine, "so that the advantages of the Chitpur site may be shared by them both, if they continue to be desirous of carrying out wet docks," so that, in short, they might share the spoil, and also the excavation of the spoil. Remembering, however, former and repeated abortive attempts on the part of companies, the Committee recommended that the East Indian Railway arrangements should be made as though a wet dock were to be made at Chitpur on the site of the excavation for the railway, by the Port Trust in the event of the proposed companies not carrying out their proposals, and that an exact estimate of the cost of the dock should be at once prepared by a competent Engineer.

The prospects of docks being made being in this uncertain state, the Committee thought that no practical result would arise from any discussion of the details of any of the schemes for docks, jetties, or wharf-walls that had been put forward by various Engineers. The Port Trust, when constituted, should themselves determine the exact character and extent of the system of jetties to be constructed by them.

* No provision for the accommodation of crews on shore appears in the estimates for the docks now under construction at Kidderpore.

Erratum.—In the first first article of this series in 7th line from bottom of 3rd column—"necessary" ought to be "unnecessary."

NOTES FROM HOME.

(From our own Correspondent.)

An invention has lately been patented for the coupling links and chains which is receiving a good deal of support om those using these apparatus, which in the case of a eak can, with the greatest ease and in the course of a very w minutes, be permanently and perfectly remedied. It is ectual in the case of links of any shape or length and hav g a loose piece dovetailed on the side forming a coupling connection for chains or similar articles. The link can made in one piece, but the inventors prefer making in two, one being made to slide into a dovetail on the side the link which is formed to receive it. The piece alluded when inserted in the dovetail is held securely in position one or more metal plates placed in the centre of the link d held firmly by means of a screw, nut, bolt or other equiva nt, the plates being bevelled to fit inside the link.

The old oil lamp has been superseded by gas in one of the etropolitan Railway Company's omnibuses between Portland lace and Charing Cross. Pinlsch's compressed oil gas is used, any examples of which are found on our railways. In is case a copper reservoir holding three days' supply of gas fixed under the steps. The gas is stored in the reservoir an initial pressure of 90lbs. per square inch. The reser oir supplies gas to two burners through a regulator which duces and equalizes the pressure in the burners. The vehicle efficiently lighted and so satisfactory is the result that it intended to extend the system to the rest of the Company's ock, and it is to be hoped that the other companies will llow suit in this needed improvement.

Following on the paper read at the Institution of Civil ngineers on the Conversion of Timber, in which the economy band saws was fully dwelt upon—*Industries* this week ives an illustration of a band saw constructed at Liepsig r the conversion of valuable timber into boards. This ype is generally made in three sizes, the diameter of the eaves being 47 inches, 59 inches and 71 inches for the treat ent of logs up to 27½ inches, 47 inches and 59 inches re pectively. The top sheave is carried on a double bearing pported on a slide rest with a vertical screw for tighten g the band. The band is protected as much as possible case of breakage.

The *Sanitary Record* gives an extract from a report, form g a description of the Destructor Works at Wentworth treet, Whitechapel. This Destructor consists of eight cells, built in a thickly populated neighbourhood, and it is stated hat after six months' experience, as far as its capacity goes, he experiment has proved eminently successful. Additional ells are proposed to be added.

Some very serious accidents have occurred to torpedo oats in the course of recent manœuvres off Portland, re ulting in loss of life. In two of these cases boiler explo ions show curiously similar characteristics. A searching in uiry is promised into the cause of these accidents and the esult of the inquest is awaited with much anxiety.

Mr. Tarner recently read a paper before the Society of Arts which was original and suggestive. He proposed that n the case of laying out a street improvement the elevations f proposed new buildings should be set up to a uniform scale y an official appointed for that purpose, and that if the plans hould be considered to be out of harmony the architects hould be invited to reconsider their designs.

Some data of considerable importance are given in the *Engineer* by Mr. Middleton on Portland Cement. Tests it long dates derived from the breaking briquettes varying rom the original seven days' test to 410 days and from that to 2,019 days after gauging, care being taken for the value of the experiments to arrive at a minimum rather than at a maximum result.

The paper last week at the Institution of Civil Engineers was "On the Manufacture of Salt near Middlesbrough" by Sir Lowthian Bell, in which the author described the accidental discovery of salt in the locality, and the method that was adopted by Messrs. Bell Brothers, of Port Clarence, to try the practicability of raising the salt. For raising the salt recourse was had to the method of solution, the principle being that a column of descending water should raise the brine nearly as far as the differences of specific gravity between the two liquids permitted. The author then referred to the uses to which the brine was applied, and concluded with giving some particulars of the soda industry. The next paper will be Accidents in Mines, Part 1, by Sir F. Abel.

The mechanical Engineers held their meeting at the Institution of Civil Engineers last week, when the President, Mr. Carbutt, delivered his address. In this, like other addresses of this year, the occasion is taken of reviewing the advance made during the fifty years of Her Majesty's reign on the growth of the nation in territory and wealth, and after size of the trade of the country, proceeds to account the advance made in our guns during this period. It is here shewn that very little improvement exists in the cannon cast in the reign of the Georges over the artillery of the time of Elizabeth. The infantry rifle first led the way to the improvement in cannon and the steps are recorded when the mechanical improvements rapidly succeed each other, thus bringing us to the present day. Tabular comparisons are given shewing differences between the old 68 pounder of 1837 and the 45, 69 and 110 ton guns of to-day. Machine guns are then considered and an account of works available for the manufacture of the great and expensive artillery of our time.

Following this came a paper on the construction of Canadian Locomotives by Mr. Francis Brown, of the Canadian Pacific Railway. The special character of all the engines described is their extreme flexibility, which is necessary on account of bad roads. English builders, however, refuse to make flexible locomotives, and it was pointed out in the discussion which followed the paper that in consequence of this orders for locomotives for our colonies were sent to the United States, where engines more suitable to the requirements could be obtained. The next paper was by Major English—Experiments on the Distribution of Heat in a Stationary Steam Engine, the discussion of which was adjourned.

The annual dinner was held the same evening at the Criterion at which the Duke of Cambridge was present.

The Didcot, Newbury and Southampton Railway Company have completed their line from Didcot to Winchester, but having failed to raise sufficient capital to enable them to complete their line to Southampton, are now asking Parliament for powers to construct a short line, making a junction with the South-Western Railway and for powers to run over that Company's line into Southampton.

The Blackwall Tunnel Bill promoted by the Metropolitan Board of Works, a measure to authorize the construction of a tunnel for vehicular and foot traffic beneath the Thames at Blackwall, uniting Greenwich with the opposite shore, has passed the Committee,—the opposition by the Thames Conservators, the Gas Companies and others not being very spirited.

A select committee have had under consideration the designs and plans for the proposed New Admiralty and War Office. It was shewn that the selected plans would involve an outlay of about £700,000, being at the rate of 1*s.* per cubic foot for the main building and 1*s.* 6*d.* a cubic foot for the towers and features above the roof. Considerable evidence was given to shew the advantages and the necessity of concentrating the various departmental offices that would be brought together by the proposed undertaking.

BURMA.

(From our own Correspondent.)

Mining.—The British Burma Lead Mining Co., in which so many of our local townsmen have invested, is now in liquidation. This crisis was brought about owing to one of the largest shareholders in England having insisted on the Directors of the Company to send out a mining expert to examine and report upon the locality said to contain lead ore. Eventually a Mr. Collins, a Mining Engineer, visited the mines and his report has led to this result. Many of your readers would, no doubt, be surprised at so sudden a collapse after having read the bogus prospectuses issued by the original projectors, in which enormous profits were held out to the shareholders.

Buildings.—A new departure in building in this city has been started by the Burma Construction Co., Ld. The building now being constructed for the National Bank of India is being fitted throughout with cast-iron pillars and beams, screwed with bolts and embedded in solid masonry work, thickly plastered with cement, timber only being used for doors and windows. The ceiling is also of cast-iron sheets, supported by beams of the same metal thickly covered with cement.

The evils of constructing heavy buildings on *made soil* were very apparent in the *pucca* erection only completed last year, known as "St. Philip's Church," in this town. This

building was constructed at a cost of Rs. 22,000 by a local private Engineer. The defects were soon exposed after the recent storm; the wall of the chancel was cracked throughout, and after being examined by the leading Engineers, the crack was chiefly attributed to the soil and faulty materials used in construction.

Steamers.—The Local Government at the end of last year indented on the Home Government for a stern wheel steamer of an exceptionally shallow draft for the transport of troops in Upper Burma, and we are glad to find that Messrs. Yarrow and Co. have now completed and are sending a vessel out, of the same type as those constructed by them for the Nile expedition and which proved so invaluable during the Egyptian campaign.

Agricultural Implements.—Endeavours to introduce new agricultural implements amongst the Burmese by the local Government have only partially met with success. Six Watts' ploughs were tried by the cultivators, five harrows devised by Mr. Cabaniss were lent as models and five more were made and used by the cultivators. Two horse-power threshing machines were imported from America and a new mill for pressing sugarcane. The Burmese are now only becoming masters of the implements, and although they experience and see the superiority of modern appliances, the cost is too great being the great drawback for general use. The sugarcane pressing mill was supplied by Messrs. Thomson and Mylne at a cost of Rs. 510, but that firm are now engaged in constructing similar mills at a cheaper rate.

Fishing Industry.—An experiment was made at considerable expense by Government with trawling gear at the Krishna shoal to try deep sea-fishing, and two Europeans, who were practically acquainted with the industry and working of the gear at Home, were sent out in company with expert Burman fishers to conduct the undertaking. After a fair trial the experiment was found to be unprofitable and accordingly stopped. The attempt to introduce improved appliances amongst Burman fishermen was also a failure.

RANGOON; *June* 14, 1887.

NOTES FROM CEYLON.

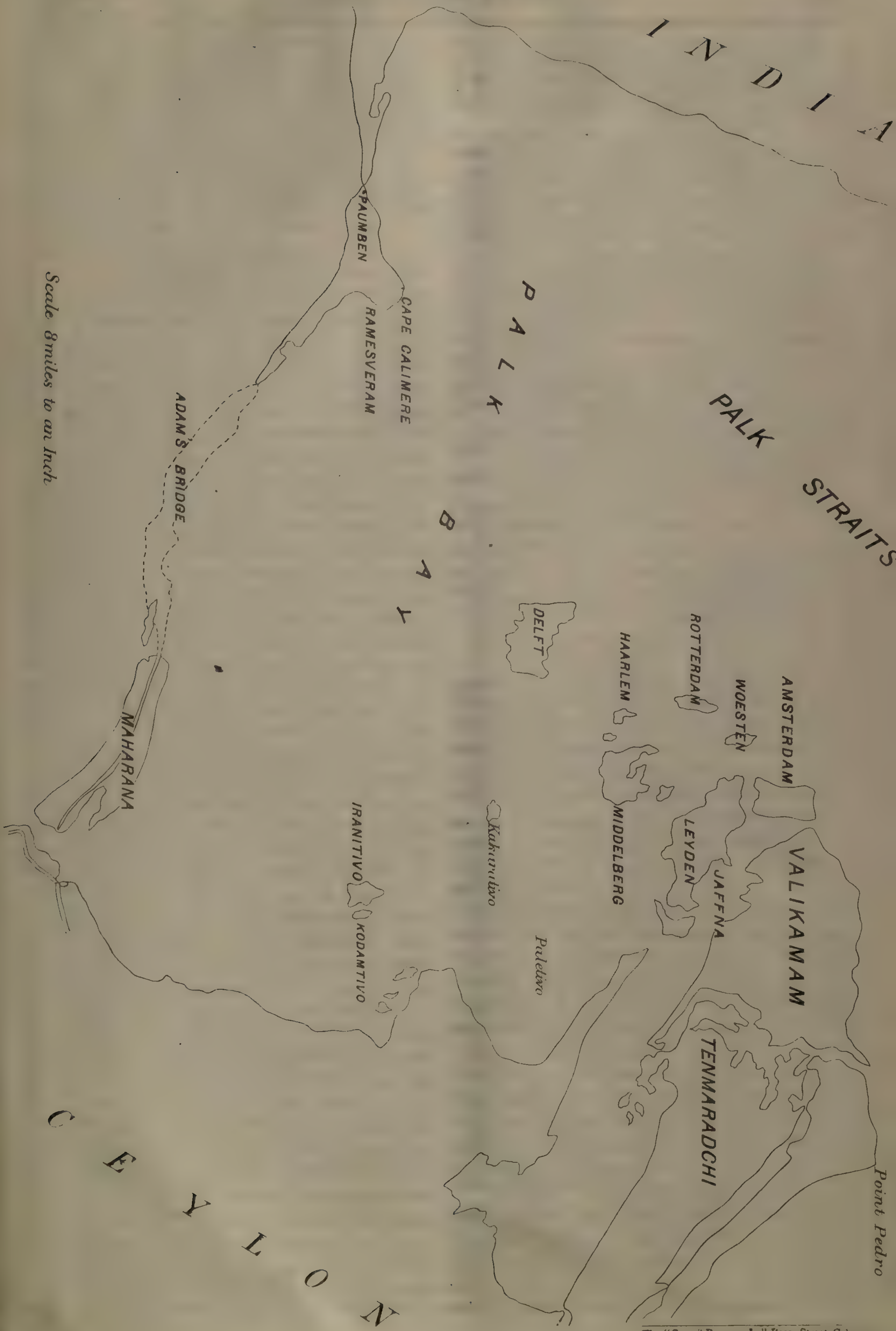
(From our own Correspondent.)

THE fight and growl over our roads still smolders, breaking out every now and then. Certainly on the old system the roads were very good to look at, but the expense of repair showed something rotten somewhere. This expense Mr. McBride estimated to reduce considerably by introducing patching and doing away with the blinding. There was one mistake made which consisted in not having the out-station overseers into the town centres, and teaching them the new procedure thoroughly.

Our Forest Department is to be organised, and for this purpose an Indian officer is to be procured for a term of five years on a salary of Rs. 1,000 per mensem, and allowances. At the end of this period, it is expected that a young officer to be trained in England, Germany and France will be sent out as head. Hitherto the systematic conservation of our forests has never been attempted, and although we have a forester for each province, still they were appointed locally and their training for such a post, I fear, in most cases was *nil*, the sole qualification being that they had a claim on the colony and had failed to be efficient in previous appointments held by them. Mr. Vincent was over here some short time ago, and if his recommendations are carried out, there is work for a very large department. The provisions of Mr. Vincent's report, if carried out, would land every second villager or rural inhabitant of Ceylon in gaol, and the reserves in the Kelani Valley between Adam's Peak and Ambagamuwa ranges on the one side and Dolosbagie on the other contain many a block highly coveted by the tea planter, more especially as some of it was blocked for sale and withdrawn on Mr. Vincent's report. This license and liberty, on the one hand, and want of organisation on the other, will now draw down to the Government many a growl and the expense will naturally be brought forward as an argument against adoption.

The Railway question has been brought before the House and is also the subject of a deputation. The Governor, Sir A. Gordon, is also said to have sent in a very strong despatch on the subject, and Sir Clementi Smith has called at the Colonial Office and given his opinions in favor thereof. The guaranteed company will surely not work smoothly with a slow and cautious Government monopoly forming the other and larger half. Even Mr. Prestage, of the Darjeeling Railway, when here, didn't jump at the proposals. Although His Excellency gave him a private interview and placed the workshops at his disposal to practically show his system and cost on a mile of line, he didn't find it convenient to stay long enough and to make a show, and so poor Uva gets neglected in spite of her being now the largest and always the most certain exporter of coffee. Why should she be so neglected or unfortunately badly treated when she possesses the planting member of the Legislative Council? She has sent abroad her growl on the disgraceful state of her roads to Colombo and Newara Eliya and now she seems in such a bad state as not to have even her route to Batticaloa safe for transport, in consequence of the bridge over the Maha-oya (East) being submerged during the yearly-occurring heavy floods. The river rises 3 feet over the roadway platform, and on one occasion lately the subsidiary waterway approaches on both sides of the bridge yielded to the force of the current, being almost entirely destroyed, while the main work withstood the force of the water. The history of this bridge is singular. The trace of the road was laid out by a member of the Survey Department, who seems to have based his flood levels on what he saw in his one-season residence and what he could gather from the few natives who chanced to pass through the dense forest in the rainy season; most probably fictitious altogether, as natives would not, even if they could, travel in rainy weather, more especially through jungle. When the road was under construction the District Engineer determined to leave the erection of this bridge to the last, so that he might satisfy himself during three seasons as to the height attained by maximum floods during that period; and satisfied himself so far as to find the floods rose 6 feet above the levels shewn before. Alarmed at this disturbance to his calculation, in his report he begged the Director to visit the spot and consult. This the then Acting Director declined to do, and called on the Provincial Engineer to make his estimates on his own responsibility. This was done, and the amount asked for being so much greater than the original estimate, aroused suspicion and further inquiry was ordered. The Provincial Engineer was removed, and a bridge constructed costing far less than his estimate, the reduction being attained through lowering the bridge 3 feet, and consequently of its approaches throughout, with the above mentioned result of the floods flowing 3 feet in depth over the platform and the chance at any moment of total destruction (incurring a waste of £15,000 to £20,000) and the complete stoppage of traffic, for many months, coastwise from Badulla, Madulsuri and Muneragala.

The company to take up the concession granted to make and work the Paumban canal seems to be making steady, if slow, course towards being fully launched, and at this juncture interest would attach to Captain Taylor's report of his inspection, wherein he says that on steaming through the Paumban passage, he pointed out to the Chief Engineer the shoal line 3¾ to 3½ from Shingle islet to main body of island. This must be canalled; a mere passage dredged through sand would soon be filled up again owing to the strong heavily charged with sand current. On landing at Paumban, he inspected the trial pits ordered by the Madras Government some years ago and thence went to Ramesveram. He adds that this will be a work of which it is impossible to overrate the difficulties. They are more of a technical marine nature than a simple engineering action. If a canal is formed, the sand-laden currents will at some seasons run up and down it and form bars at either end. If a dredged passage only is attempted it will soon silt up. If the passage is set aside on account of these difficulties, the only other one that can be relied on will 30 miles south of Point Pedro, which will increase the distance from Colombo to one even greater than rounding the Basses and Dondra head. The simple cut through Ramesveram island is simple enough, but maritime dangers, delay and expense attend all the other features of the design. Colonel Hasted adds:—The Pass itself is understood to be clear, but the shoal below has accumulated and dredging seems to be very necessary there. Nothing is known here about a reference made to the Secretary of State for a suitable dredger and it may be that in the face of the proposal to cut the ship canal through the Ramesveram island, a dredger may be considered unnecessary. But in the proposed agreement between the company to be formed for cutting the canal and the Secretary of State it is specially provided that the Paumban Pass shall not be



The "STAR" Press. 19 Lall Bazar Street. Calcutta.

interfered with, and as a canal cannot be available for some years, even if country craft will ever use it, it seems very desirable that a dredger should be obtained as early as possible. Speculation on the prospects of the canal seem unnecessary, but on examining the ground on the proposed line of the canal and studying the charts, the conclusion arrived at was, that the canal itself, with immediate approaches, was feasible, if sufficient money was spent but that the real difficulty will be found with shoals lying between Point Calimere and the island of Ceylon, through which it seems almost impracticable to keep open a passage of sufficient depth to enable large ships to navigate.

Map annexed.

AERIAL NAVIGATION.

(Translated from *Annales Industrielles* for INDIAN ENGINEERING.)

THE AERIAL BUOY: ITS INSTABILITY.

II.

WE will for the present examine the conditions of equilibrium to which the aërostat is subject in its ordinary state, that is, when it is slack and able to expand and shrink freely. Under these conditions, the pressure of exterior air and the interior gas are at an unvarying equipoise and there results, therefore, that the density of these two fluids are continually in the same relation to each other.

To simplify the question, if our balloon contains * 1 kilogramme of common hydrogen (which is 6½ times heavier than atmospheric air) this quantity of gas which will be unvarying in weight while the balloon is slack, will displace at all height 6 kilogrammes 500 grammes of air, and in pursuance of the principle of Archimedes, will rise with a force of 5 kilogrammes 500 grammes difference between the weight of the displaced air and that of the hydrogen.

As this force is independent of height, it will be seen that if our balloon carries ballast to be in equilibrium at a certain height, it will keep that exact equilibrium at all others, whence it results, as we had at first observed, that it shares the properties of the buoy immerged in the ocean, and that it will rise or descend indefinitely under the influence of the slightest lightening or over-weighting. This is the case with the submarine boat, and it may be imagined what difficulties have to be encountered in order to transform into an aërial vessel an apparatus subject to constant oscillations like a pair of unsteady scales. †

But it will be said, if this argument be sound, a balloon weighing a little less than the air at the moment of leaving the earth, will, therefore, rise incessantly and will reach the stars! and who would ever wish to embark in a balloon with the prospect of an indefinite excursion in the interplanetary spaces? No; the balloon will stop, for our argument supposes that the gas does not completely fill its case; therefore, since it dilates unceasingly during the ascent, a moment will soon arrive when the case will be completely filled and when the hydrogen will escape by the safety valve mentioned above; from that moment as the weight of gas contained in the balloon goes on diminishing, the same thing will occur in the ascensional force, the two being continually in proportion (5½ in the case of common hydrogen). The movement will, therefore, be checked and will stop very soon.

In order to make it clearer, we will again take a numerical example, and since it is now no longer the weight but the volume of gas which is unvarying, we will consider, for the sake of simplicity, a balloon of one cubic metre, in which we will place one cubic metre of common hydrogen.

If we are at sea-level, the weight of this cubic metre of gas will equal 6 kilogrammes 200 grammes; the weight of the cubic metre of air, 1 kilogrammes 300 grammes; and the difference of the ascensional force of the cubic metre of gas at the level of the sea will equal 1 kilogrammes 100 grammes.

Let us now imagine ourselves at a height at which the atmospheric pressure is reduced by one-half; according to the law of Mariotte, the same thing will occur with regard to the preceding weights and consequently with their difference of ascensional force, at this height equal to about 5,500 metres, about 3 English miles, the gas in our balloon could not raise more than 0 kilogrammes 550 grammes.

If, however, it carries ballast at sea-level in such a manner as to leave it 0 kilogrammes 550 grammes of ascensional force it will completely lose that force on rising to a height of 5,500 metres, it is there that it will stop, or, in other words, will reach its zone of equilibrium.

Generally speaking, a balloon full at sea-level and relieved of $\frac{1}{10}$, $\frac{2}{10}$, $\frac{3}{10}$ of the total ascensional force of its gas, will rise to the height where the pressure of the atmosphere has correspondingly lost $\frac{1}{10}$, $\frac{2}{10}$, $\frac{3}{10}$, &c., of its value.

It is interesting to know at what height these reductions in the pressure of the air will correspond. We have worked out the results in a very simple table, in which will also be seen the weight at which it will be necessary to relieve a full balloon of 1,000 metres to enable it to rise to different heights.

Weight ef ballast thrown out.	Pressure of the air, taking as unit the pressure at sea-level.	Height Corresponding.	Remarks.
0 c. m.	1 0	0 m.	The third column indicates the heights attained by a balloon of 1,000 c. m. filled with common hydrogen when unballasted of the weights in the first column. The heights in question are given at an average of 50 metres, they vary with atmospheric conditions.
110	0 9	800	
220	0 8	1,800	
330	0 7	2,900	
440	0 6	4,100	
550	0 5	5,500	
[illegible]	0 4	7,300	
770	0 3	9,600	
880	0 2	12,800	
990	0 1	18,300	
1,100	0 0	Infinite.	

This table shews that the more ballast is thrown out, the higher a full balloon will rise. The height thus attained is called the zone of equilibrium. Between this zone of equilibrium and the earth the balloon is slack and consequently unstable, the slightest overweight brings it back to the earth, the slightest lightening returns it to its zone of equilibrium.

Now these overweightings and lightenings are continually taking place during aërial voyages; the intensity of the solar rays, the nature of the soil, damp, snow, rain and many other causes too numerous to mention here, modify at every instant the sensitive equilibrium of the aërial boat, which cannot be maintained at an almost unvarying height but by the constant help of the aëronaut.

But the means of which the latter avails himself are of the most rudimentary kind. In spite of innumerable attempts, some of which are most ingenious, the only practical means of checking the accidental variations of the ascensional force of balloons consist of the throwing out of ballast, and of the escape of a certain amount of gas. These very effectual means have one most palpable defect. The ballast to be thrown out is very quickly exhausted and the disarmed aëronaut must resign himself to drop down to the earth as soon as an accidental overweight occurs, and it will not be long before this happens.

In this lies the secret of the short duration of aërostatic voyages, even of those undertaken in perfectly impermeable balloons.

Therefore, the aërostat should in no way be compared to a vessel floating on water. It is an unstable buoy, which even when it is possible to control its movements cannot be of much service, since it can float in the air for a few hours only. Can we at the present day remedy this defect, and can we successfully defeat this altitudinal instability? Yes; undoubtedly, for we now possess light and powerful propellers, which it will suffice to attach by means of horizontal screws to produce energetic ascending or descending motions which the aëronaut will direct in the wished for direction in order to maintain his apparatus in perfect equilibrium. ‡

A.

(To be continued.)

* 1 Kilogramme - 2·2046215lb. avoirdupois or 1,000 grammes.

† The instability of these slack balloons can be otherwise explained.

Let us place, at the level of the sea, one cubic metre of common hydrogen in a balloon capable of holding several cubic metres and set aside the weight of its case.

The weight of this cubic metre of hydrogen is equal to 200 grammes; the weight of the cubic metre of air equals 1,300 grammes; the difference 1,100 grammes is the ascensional force at sea-level of the cubic metre of hydrogen and also that of the balloon.

We will now rise to a weight of 5,500 metres (about 3 English miles) that is, to a zone where the atmospheric pressure is reduced by one half. In pursuance of the law of Mariotte:

1. The hydrogen will have doubled in weight and we shall have two cubic metres instead of one.

2. The specific gravity of the air will be reduced by one half, let us say to ... ... 650 gr.

The specific gravity of the hydrogen will be reduced to 100 gr.
and the specific ascensional force to ... ... 500 gr.
that is to say, to one-half of its value at sea-level.

We have, therefore, a double volume of gas, of which, however, each cubic metre will raise twice as little, therefore the ascensional force has remained the same. It is easy to see that this will apply to every height, provided the balloon is slack and that the gas can expand and contract freely within its case.

‡ Similar means are used in Nordenfeldt submarine boat, recently experimented with success.

The Gazettes.

PUBLIC WORKS DEPARTMENT.

Central Provinces, June 18, 1887.

With reference to Notification, dated the 1st June 1887, Mr. G. G. White, Executive Engineer, reported his arrival at Kamptee on the forenoon of the 7th current.

With reference to Notification, dated the 1st June 1887, Mr. M. Leslie, Executive Engineer, surrendered, and Mr. G. G. White, Executive Engineer, assumed, charge of the Kauhan Division on the forenoon of the 13th current.

India, June 18, 1887.

Mr. C. C. B. Knapp, Executive Engineer, 3rd grade, sub. *pro tem.*, Burma, temporarily employed on the Establishment under the Director-General of Railways, is appointed to officiate as Deputy Consulting Engineer for Railways, Madras.

Mr. H. A. S. Fenner, Superintending Engineer, 3rd class, temporary rank, is permanently promoted to that grade, with effect from the 28th March 1887.

Mr. W. C. Rennie, Executive Engineer, 1st grade, State Railways, is granted furlough on medical certificate for twelve months, with the usual subsidiary leave, with effect from the 26th May 1887.

Mr. J. M. Span, Executive Engineer, 1st grade, Assam, is permitted to retire from the service of Government, with effect from the 3rd June 1887.

The Governor-General in Council is pleased to order the following temporary promotion and reversion in the Superintending Engineers' classes, with effect from the date specified :—

Lieutenant-Colonel J. H. Crowdy, R.E., Superintending Engineer, 2nd class, temporary rank, to be Superintending Engineer, 3rd class, temporary rank, with effect from the 14th June 1887.

Mr. H. A. S. Fenner, Superintending Engineer, 3rd class, to be Superintending Engineer, 2nd class, temporary rank, with effect from the 14th June 1887.

Mr. D. Campbell, Honorary Assistant Engineer, 1st grade, whose services have been lent to the Indian Midland Railway Company, is granted six months' leave on private affairs, under section 130 of the Civil Leave Code, from such date as he may be permitted to avail himself of it.

Railways.

Mr. E. H. Tuck, Assistant Engineer, 1st grade, is granted six months' leave on urgent private affairs from such date as it may be availed of.

Mr. L. H. Butcher, Assistant Engineer, 1st grade, has been granted by Her Majesty's Secretary of State for India leave on medical certificate for nine and half months in commutation of the six months' special leave granted him in Director-General's Notification, dated 25th March 1887.

Lieutenant S. L. Craster, R.E., Assistant Engineer, 2nd grade, is granted language leave for three months, with effect from such date as he may be permitted to avail himself of the leave.

Burma, June 11, 1887.

Lower Burma.

Mr. W. R. Gilbert, Executive Engineer, 3rd grade, is granted 13 days' privilege leave, with effect from the 7th instant.

Mr. C. F. McLeod, Assistant Engineer, 2nd grade, is temporarily transferred from Rangoon to the Tharrawaddy division.

With reference to *Burma Gazette* Notification, dated the 10th May 1887, Mr. W. R. Gilbert, Executive Engineer, 3rd grade, made over, and Mr. J. C. Wyatt, Executive Engineer, 4th grade, received, charge of the Thayetmyo Division on the afternoon of the 31st May 1887.

Burma State Railway.

Mr. A. R. Lilley, Executive Engineer, 3rd grade, is posted to the charge of the Rangoon district, Burma State Railway (open line), with effect from the 1st June 1887.

N.-W. P. and Oudh, June 18, 1887.

Railway Branch.

Major R. R. Pulford, R.E., Executive Engineer, 1st grade, and Personal Assistant to the Chief Engineer, Buildings and Roads Branch, is appointed Assistant Secretary to this Government in the Public Works Department, Railway Branch, in addition to his other duties, with effect from the date on which he took over charge of that Branch from Major T. Gracey, R.E.

Irrigation Branch.

Mr. W. B. Gordon, Assistant Engineer, 1st grade, Nadrai Aqueduct Division, Lower Ganges Canal, passed the Higher Standard Examination in Hindustani on the 5th July 1886.

Mysore, June 11, 1887.

Captain C. H. M. Kensington, R.E., having returned from furlough, assumed charge of the office of Assistant Superintending Engineer and Assistant Secretary to the Government of Mysore, Public Works Department, on the forenoon of the 3rd instant.

Mr. W. McHutchin, Executive Engineer, is permitted to proceed on privilege leave for one month and 25 days from the 3rd instant, pending the sanction of the leave by the Resident in Mysore, and subject to the approval of the Government of India.

Punjab, June 16, 1887.

His Honour the Lieutenant-Governor is pleased to sanction the following temporary promotions and reversion in the Amalgamated Engineer Establishment of the General and Irrigation Branches of the Public Works Department, Punjab, with effect from the dates specified against each :—

Mr. W. J. A. Bird, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, *vice* Mr. Hicks, promoted to Executive Engineer, 4th grade, sub. *pro tem.*, with effect from 29th November 1886.

Mr. W. J. A. Bird, Executive Engineer, 4th grade, temporary rank, to be Assistant Engineer, 1st grade, *vice* Mr. Hicks, reverted to Executive Engineer, 4th grade, temporary rank, with effect from 11th January 1887.

Mr. A. Grant, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, *vice* Mr. Hicks, proceeded on furlough, with effect from 2nd March 1887.

Mr. W. J. A. Bird, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, *vice* Mr. Parkes, proceeded on furlough, with effect from 14th March 1887.

Bahshi Ram Sing, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, *vice* Mr. Hatten, proceeded on furlough, with effect from 15th April 1887.

Mr. C. E. V. Goument, Assistant Engineer, 1st grade, to be Executive Engineer, 4th grade, temporary rank, *vice* Mr. Brodie, proceeded on furlough, with effect from 17th April 1887.

Assam, June 18, 1887.

Rai Durga Das Das, Bahadur, District Engineer, Lakhimpur District, is granted privilege leave for three months, from the 19th July 1887, or such date as he may be permitted to avail himself of the same.

Mr. H. Kench, Executive Engineer, 4th grade, temporary rank, is, in the interests of the public service, transferred temporarily from the Khasi and Jaintia Hills Division to the Lakhimpur District, and appointed to officiate as District Engineer of Lakhimpur, *vice* Rai Durga Das Das, Bahadur, proceeding on privilege leave.

Indian Engineering Patent Register.

SPECIFICATIONS of the undermentioned inventions have been filed under the provisions of Act XV. of 1859 in the Office of the Secretary to the Government of India in the Home Department :—

The 30th May 1887.

82 of '86.—Modho Ram Ojah, (late) Sub-Engineer, Public Works Department, resident of Mainpuri, North-Western Provinces.—*For an irrigation machine (or rather a modification and improvement in the Persian wheel which natives call in its present rude form a "Rahut") for raising water to small heights, 3 to 15 feet, for irrigation of fields.*

59 of '87.—Edward Arthur Roberts and Frederick Charles Roberts, carrying on business under the style or name of Roberts and Son, of 22, Harp Lane, in the City of London, England.—*For an improvement in stoppers for bottles.*

60 of '87.—Edward Planta Nesbit, of No. 26, Priory Road, Wandsworth Road, in the County of Surrey, England gentleman.—*For an improvement in tanning.*

The 13th June 1887.

132 of '86.—Neil Fox, of Shahjehanpore, in the North-Western Provinces of India, Indigo Planter.—*For an arrangement for adjusting the Rollers of Sugarcane or other Crushing Mills.*

224 of '86.—Arthur Campbell Rogers, Assistant Engineer, Oudh and Rohilkhand Railway Company, Limited, Saharunpore, North-Western Provinces, India. —*For "Rogers' Patent Improved Centre Board Sugarcane Mill."*

24 of '87.—William Adolph Leipner, of Hampton Park, Bristol, in the County of Gloucester, England, Electrician. *For an improvement in dynamo-electric and electro-dynamic machines.*

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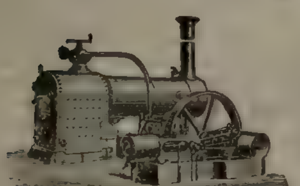

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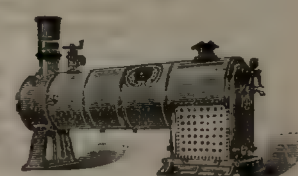

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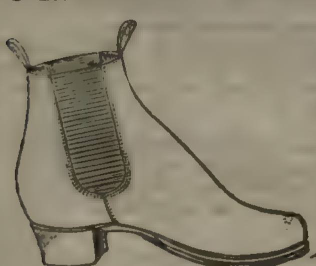

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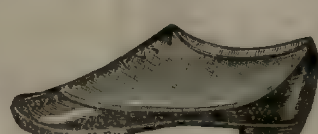

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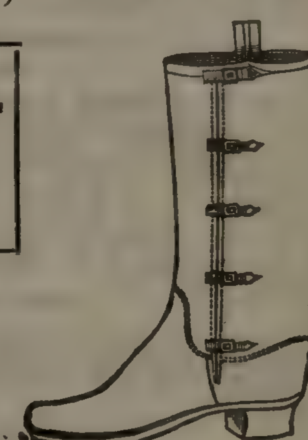

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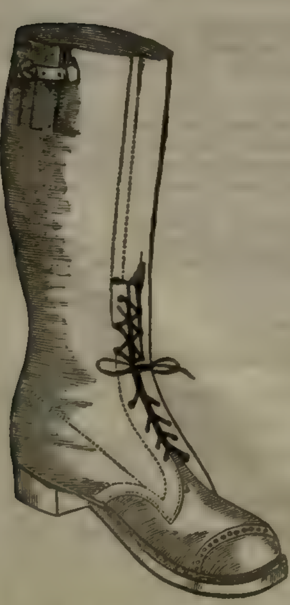

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